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NL

August 30 1990

Via Federal Express

Mr. John Kelley, Acting Chief
Remedial and Enforcement Response Branch Chief
U.S. Environmental Protection Agency
Region V
230 South Dearborn
Chicago, Illinois 60604

Re: NL/Taracorp Superfund Site
Granite City, Illinois

Dear Mr. Kelley:

NL Industries Inc. ("NL") hereby tenders a good faith offer regarding the NL/Taracorp Superfund site in Granite City, Illinois, which is more specifically described herein. This offer is in accordance with the U.S. Environmental Protection Agency's ("U.S. EPA") Interim Guidance on Notice Letters, Negotiation and Information Exchange dated February 23, 1988. This offer should not be construed as an admission of liability or waiver of any right or defense either company may have with respect to any present or future alleged liability for conditions at or near the NL/Taracorp Superfund site. Moreover, it is without prejudice to the assertion that all or a portion of the alleged liability in question may be attributable to other parties.

We are available to meet with you at your earliest convenience to commence negotiations regarding our good faith offer, and we further believe that an early meeting would be constructive in explaining the basis of the offer.

In conjunction with the offer we tender the following documents:

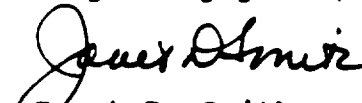
1. A detailed statement of work identifying how the PRPs plan to proceed with the work.
2. A statement identifying the protocol for selection of a consultant for the work.
3. Comments on the U.S. EPA's Record of Decision and the Scope of Work.

4. A paragraph-by-paragraph response to U.S. EPA's draft consent decree, including the provisions pertaining to reimbursement of U.S. EPA for past response, oversight and administrative costs, and release from liability and reopeners to liability. New language is underscored; omitted language has been replaced by brackets [].
5. The Annual Report of NL documenting the company's financial ability to perform the work.

At the threshold, we think the 500 parts per million cleanup level for lead-in-soil in residential areas set forth in the Record of Decision ("ROD") is overly protective and unwarranted by U.S. EPA policy. Nevertheless, we offer a means by which the Agency can move ahead on matters as to which there is no dispute by conducting further analysis to ascertain the appropriate remedy for the site. Such analysis would include a blood lead study and further soil sampling, and would focus on collecting the best scientific facts to define the remedy. In addition, we are prepared to carry out those portions of the ROD that are consistent with this proposal, such as the location of additional buried battery case materials in neighboring communities, the design of a cap for the Taracorp pile, and other elements as set forth in the enclosed scope of work. Finally, subject to an allocation, we express willingness to commit to a remedial design/remedial action program based upon the outcome of the further studies.

We believe the offer set forth herein fulfills the requirements of the statute, provides the necessary investigations to insure protection of human health and the environment, is in accordance with sound engineering practices, and is the most cost effective means by which to proceed. Please contact me at your earliest convenience to discuss the offer

Very truly yours,



Janet D. Smith

JDS:ml

Enc.

Protocol for Selection of Consultant for RD/RA
NL/Taracorp Superfund Site
Granite City, Illinois

1. Supervision of work by licensed professional engineer.
2. Assess general reputation with respect to supervision and performance of RD/RA work.
3. Recommendations of knowledgeable persons in the field.
4. Demonstrated work experience in Superfund area and/or at similar sites involving knowledge of all pertinent laws, regulations and guidance.
5. Demonstrated experience with U.S. EPA and/or Illinois EPA.
6. Selection of contractor through competitive bidding process.
7. Access to and use of laboratory certified and approved by U.S. EPA and state EPA.
8. Experience on RD/RA type projects.

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NL INDUSTRIES, INC.



ABOUT THE COMPANY

NL Industries, Inc. (NL) is the world's fourth largest producer of titanium dioxide pigments. These pigments provide whiteness, brightness and opacity to a wide variety of important products which include paints, plastics, paper, fibers and ceramics. NL also produces specialty chemicals and is the world's largest manufacturer of rheological additives for solvent based systems. These additives are used to control the flow and leveling properties of paints, grease, inks, caulks, sealants, adhesives and coatings. NL conducts its titanium dioxide pigments operations through its wholly owned subsidiary, Kronos, Inc. Upon completion of its internal restructuring, NL's specialty chemicals operations will be conducted through its wholly owned subsidiary, Rheox, Inc.

NL, headquartered in Houston, Texas, currently has over 3,450 employees involved in research, sales and production in eight countries throughout the world. The Company strives to be a good corporate citizen and maintain good labor relations with its employees in every country in which it operates. It is these good labor relations and our employees' commitment to excellence that helps the Company enhance shareholder value, achieve its environmental objectives, and provide its customers with the best products available.

The Company's common stock is listed on the New York and Pacific Stock Exchanges and trades under the symbol "NL."

ABOUT THIS REPORT

NL Industries continues to strive to improve the quality of financial communications to its shareholders. This annual report provides an overview of the Company's products, financial condition and results of operations in a summary format. For additional information required to be furnished to shareholders annually in accordance with the rules of the Securities and Exchange Commission (including audited consolidated financial statements and related notes containing information concerning litigation and other contingencies to which the Company is subject), please refer to the appendix to the Company's proxy statement which accompanied the mailing of this annual report. NL's products are used worldwide to make inks brighter and paper whiter; in fact, this annual report is printed on paper containing titanium dioxide pigments.

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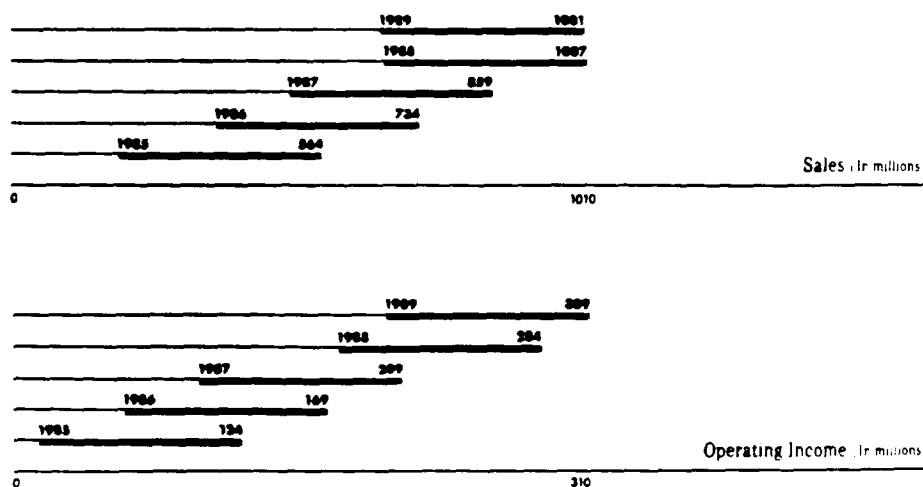
FINANCIAL HIGHLIGHTS

1989

1988

(In millions, except per share data)

Net sales	\$1,000.9	\$1,007.0
Operating income	308.6	284.1
Income before income taxes	278.1	261.1
Income from continuing operations	170.3	134.2
Net income	172.9	163.0
Capital expenditures	83.4	70.6
Cash and cash equivalents	165.6	138.4
Marketable equity securities:		
Current	101.0	—
Noncurrent	449.0	—
Total assets	1,512.3	841.4
Notes payable and current maturities of long-term debt	465.9	19.5
Long-term debt	383.9	183.3
Series A preferred stock	5.0	10.0
Common shareholders' equity	132.3	145.4
Income per common share:		
Continuing operations	\$ 2.57	\$ 2.02
Discontinued operations	—	.32
Extraordinary items	.04	.11
Net income	\$ 2.61	\$ 2.45
Weighted average common shares outstanding	66.0	65.9



TO OUR SHAREHOLDERS

W

We have just concluded an exciting year at NL Industries. During 1989, we increased our income from continuing operations 27 percent; we began production at our new chloride process titanium dioxide pigments plant in Langerbrugge, Belgium; we began construction of our new titanium dioxide pigments plant in Lake Charles, Louisiana; we continued to successfully implement our environmental initiative worldwide; we restructured our international chemicals operations; and we purchased substantial holdings in Georgia Gulf Corporation and Lockheed Corporation.

The Company reported income from continuing operations of \$170.3 million for 1989 on sales of \$1,000.9 million which was an increase of 27% from the \$134.2 million in income from continuing operations reported for 1988 on record sales of \$1,007.0 million. Most of these 1989 earnings were contributed by the titanium dioxide pigments business segment due to a strong worldwide demand that kept customers' inventories below normal levels and supported prices.

We are optimistic about the outlook for titanium dioxide pigments for the 1990s. Demand is expected to continue to grow at a healthy but slower pace than it did during the 1980s. In our opinion, this means that additional capacity will be required to meet demand and that prices should remain firm in our major markets.

In July 1989, we began construction of our new titanium dioxide pigments plant in Lake Charles, Louisiana. This plant will add 80,000 metric tons of titanium dioxide pigments production to our present worldwide capacity of 320,000 metric tons. When this plant becomes operational in late 1991, NL Industries will begin the production of titanium dioxide pigments in the United States for the first time since 1982.

The Company began an internal restructuring in 1989, which is expected to be completed in mid-1990, to better meet the challenges of diverse customers in myriad geographic markets. Two companies, Kronos, Inc., and Rheox, Inc., will operate respectively the titanium dioxide pigments business and the specialty chemicals business of the Company. This approach will allow each company to better direct its efforts towards new product development and marketing for its specific customers.

In 1989, we also completed an organizational restructuring of our European and Canadian operations through the establishment of Kronos International, Inc., based in Leverkusen, West Germany. This change in organization better positions NL to pursue further expansion opportunities for our titanium dioxide pigments business in other parts of the world. It also enables us to pursue more effectively other business opportunities with a view to enhancing shareholder value.

The guiding principle of our management team is return on investment. We look first at our basic businesses to see if they present opportunities for significant returns. This approach led us, for example, to invest \$133 million in Canada and Belgium to build new chloride process titanium dioxide pigments facilities and to commit \$250 million in capital to build a new chloride process plant in the United States. Likewise, we sold our Spencer Kellogg specialty resins business for \$86 million because the returns achievable through operations did not warrant a continued investment. The Company realized a pre-tax gain of approximately \$25 million on the disposition.

We also consider investments outside our basic businesses when, in our view, opportunities for greater returns arise. Thus, for example, this year we acquired a 9.9% stake in Georgia Gulf Corpora-



Harold C. Simmons

tion for \$90 million and an ownership position of 18.9% in Lockheed Corporation for \$537 million. Georgia Gulf is a commodity chemical producer based in Atlanta, Georgia. NL acquired its Georgia Gulf shares at an average cost of \$39 per share. We concluded in January that we would like to acquire all of Georgia Gulf, if we could do so at a price of \$45 per share, and we made a tender offer for that purpose. Management of Georgia Gulf recently proposed a revised recapitalization plan that appears to offer more than \$45 per share in value to Georgia Gulf's stockholders. Since we did not think it desirable to raise our price, we let our tender offer expire and now expect to support the revised recapitalization plan. If we realize \$45 per share in value, we should recognize a pre-tax gain of more than \$14 million on this investment.

NL and Kronos acquired an 18.9% interest in Lockheed based upon its underlying strengths. Over the past year, however, several developments caused us to become concerned about Lockheed's performance.

- Lockheed announced two huge write-offs, totalling \$465 million, on important defense contracts.
- Lockheed's reorganization plan, announced in April 1989, was a failure in our view.
- From August 30, 1989, to February 14, 1990, Lockheed's stock price dropped from \$54 1/4 to \$39 1/4—a decline in aggregate market value of over \$1.3 billion.
- Further examination of Lockheed's financial reports reveals what in our judgement is a lack of focus on return on investment and a poor track record in diversification efforts.
- Several Lockheed actions, like formation of a leveraged ESOP and opposition to shareholder rights initiatives, we believe have shown a disregard for shareholder values and rights.

NL had an unrealized loss of \$69 million on its Lockheed common stock as of year end, and an additional \$36 million at recent prices. To address our concerns with Lockheed's direction we asked for representation on Lockheed's Board of Directors. Lockheed refused to give us any seats. To obtain representation on Lockheed's Board and to press for several shareholder rights initiatives being considered, we assembled a slate of directors to run in opposition to Lockheed's nominees at Lockheed's annual meeting on March 29, 1990. At the time of this writing, the results of the election are not available. Regardless of the outcome of the election, we intend to monitor our interest in Lockheed carefully.

We would like to take this opportunity to welcome Lawrence A. Wigdor to our management team as president and chief executive officer of Kronos and chairman and chief executive officer of Rheox. Larry has over 25 years experience in the international coatings, chemicals and plastics industries and replaces Fred W. Montanari who has retired after 21 years of service. Michael J. Kenny, a 20 year NL veteran, was named president and chief operating officer of Rheox.

We enter the 1990's with much enthusiasm. The markets for our products are global, and we firmly believe that we have the personnel, manufacturing capability and financial strength to increase our market share while developing new, higher quality products.

Harold C. Simmons

Harold C. Simmons
Chairman

J. Landis Martin

J. Landis Martin
President and Chief Executive Officer

April 4, 1990



J. Landis Martin

KRONOS ENVIRONMENTAL INITIATIVE

The Company is committed to manufacturing titanium dioxide pigments and rheological additives through production methods and processes that minimize waste yield and help protect our environment. NL Industries is implementing these objectives worldwide through an effort known as the Kronos Environmental Initiative.

This initiative has made NL's plants safer for the environment, the health and safety of our employees, our neighbors, and those who use our products; and it has enhanced NL's competitive position.

The greatest share of NL Industries' operating business (90%) is the production and marketing of titanium dioxide pigments. The general economic outlook for titanium dioxide pigments has been improving since the late 1970s, and several manufacturers have allocated funds principally to expand their production capacities. NL has both improved its production processes to more environmentally compatible methods and expanded capacity.

We believe NL is now a leader in the area of environmental improvements, and soon other titanium dioxide pigments manufacturers may have to invest to meet the environmental standards being set worldwide. Some nations' laws, which require conversion to more environmentally acceptable processes, went into effect in 1989 and other countries have mandated compliance by 1993.

In our view, enforcement of these deadlines will improve NL's competitive situation. NL has nearly concluded its conversion strategies and can concen-

trate on further development of improved products and the continual upgrading of our processes.

Manufacturing Process

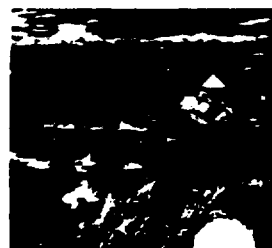
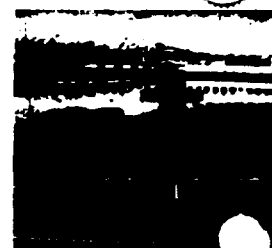
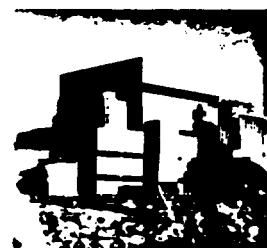
The raw materials used to produce titanium dioxide pigments are ilmenite, upgraded ilmenite (slag), and rutile. The differing chemical composition of these minerals dictates the processing and manufacturing methods used. Rutile is used exclusively in the chloride process. Ilmenite and slag may be used in the chloride and sulfate processes.

Upgrading the Processes

The Kronos Environmental Initiative began in 1983 with the publication of our goals and objectives, but it traces its origin back to 1948 when experiments and research began aimed at upgrading the sulfate process to reduce discharge of waste acid into the sea or other bodies of water.

Several of these early efforts were partially successful while others proved to be blind alleys. However, this initial research was followed by work directed at finding more environmentally compatible processing methods for the manufacture of titanium dioxide pigments. Eventually, the chloride process, which utilizes slag or rutile, emerged as the one with the greatest possibilities for success in commercial production.

In 1966, construction of a prototype plant to manufacture titanium dioxide pigments using the chloride process began in Leverkusen, West Germany. This plant was successful and was followed by the construction of a major chloride process facility there.



The capacity of this plant more than doubled between 1983 and 1985.

The technology developed during the 1980s, much of it proprietary, substantially reduces waste disposal problems. The chloride process is based on a recycling system which has relatively little effect upon the environment. The waste acid from the sulfate process is either recycled for use in the manufacturing process or converted into gypsum for use in landfills.

All of NL's European plants now use either the sulfate process, together with reprocessing or neutralization of waste acid, or the low waste yielding chloride process. A new plant under construction in Lake Charles, Louisiana, expected to be operational late in 1991, is designed to operate exclusively with the chloride process. A facility constructed in 1987 in Varennes, Quebec, Canada, utilizes both the chloride process and the advanced sulfate technology.

Waste Acid Disposal

A pilot plant for recovering waste acid from sulfate production was constructed in Leverkusen in 1982. Field experience and laboratory research accumulated here became the basis for the design of a waste acid concentration facility at Nordenham, West Germany.

Some beneficial by-products have been developed as part of NL's initiative to solve the problem of spent acid disposal. In the sulfate process, a by-product separates as crystalline copperas. This material

was once discarded as worthless, but research discovered it has an important use as a water treatment chemical for clarifying waste water and regenerating natural bodies of water.

When copperas is added during sewage treatment, it reacts with such chemicals as dissolved laundry detergents and industrial wastes, transforming them into insoluble particles which can then be more easily extracted with straightforward filtration and sludge sedimentation methods. Also, copperas can be used to reduce algae growth in freshwater lakes by reacting chemically with dissolved phosphates.

Another benefit of a titanium dioxide by-product emerged at the Fredrikstad, Norway, plant. The waste acid produced by the sulfate process is neutralized and then disposed of in a unique manner. At the southern end of the beautiful Oslofjord is Langoya Island, which is composed of limestone. For years, the limestone was mined leaving unsightly craters. The waste acid from our Fredrikstad plant now is converted into gypsum and used to fill the craters. When the island is completely restored, it could be used for commercial or recreational purposes.

The appendix to the Company's proxy statement, mailed with this report, contains additional information about environmental regulatory matters and litigation to which the Company is a party. These matters relate principally to businesses in which the Company is no longer engaged.

The waste acid concentration facility at Nordenham, West Germany.

Copperas, a bi-product of the sulfate process, is an important water treatment chemical.

An island in the Oslofjord is being restored by using waste acid that has been converted into gypsum.

TITANIUM DIOXIDE PIGMENTS

A

s part of the Company's internal restructuring, NL Chemicals, Inc. was renamed Kronos, Inc. and operates the Company's titanium dioxide pigments business. This reorganization will allow management to focus on and better align this portion of our chemicals business to meet our customers' growing needs in various geographic markets.

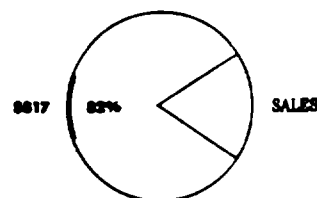
Kronos had a very successful year in many markets. It is currently the world's fourth largest producer of titanium dioxide pigments with annual production of 320,000 metric tons. In September, 1989, at Langerburge, Belgium, a new 40,000 metric ton capacity plant went from completion of construction to rated production capacity in less than a year due largely to the strong performance of its employees. This replaced 40,000 metric tons of sulfate capacity and put Kronos in compliance with the new environmental requirements of the European Community. Construction began on a new plant in Lake Charles, Louisiana, which will increase the

Company's capacity by another 80,000 metric tons when it begins operations in late 1991.

Titanium dioxide pigments are some of the most important pigments in the world. These pigments play a significant role in the manufacture of plastics, paper, paint, ceramics, textiles, and many other products. They are utilized in myriad applications throughout consumer households. Kronos currently produces about 11 percent of the titanium dioxide pigments consumed throughout the world.

Future titanium dioxide pigments growth is likely to be slower than the five percent annual rate experienced during the last five years, when demand soared due to worldwide economic growth. In general, growth rates in North America and Western Europe are expected to return to historical levels which approximate GNP growth. Growth rates are expected to remain strong in most export regions with the Far East, in particular, growing approxi-

Titanium Dioxide Pigments As a Percent of Total NL Operations (In millions)



mately four percent annually.

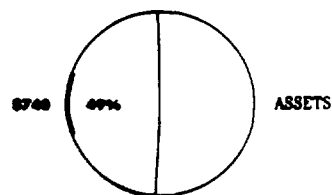
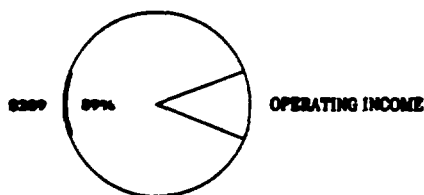
In late 1989, titanium dioxide pigments supply/demand became more balanced and as a result inventories increased from their critically low levels.

Demand for titanium dioxide pigments is driven by demand in the end-use markets, such as paint, paper and plastics, which are generally considered "quality-of-life" markets. As such, their demand is influenced by the relative economic well-being of the region served. For example, white plastic trays suitable for microwave cooking are rapidly replacing metal foil for frozen foods, brightly painted automobiles are fashionable, interiors and exteriors of houses are being painted in lighter tones, and the high-tech, personal computer industry has created a market for light-colored plastic housings.

Demand for pigments is worldwide with North America being the leading consumer closely followed by Western Europe. The United States, in particular,

uses about one-third of the three million tons produced annually due to the larger use of more high quality coated paper and magazine stock in North America than in most other regions of the world. These products require considerable amounts of titanium dioxide pigments to increase the opacity of paper and to brighten inks. Kronos intends to supply this market more effectively from a new \$250 million plant under construction in Lake Charles, Louisiana. This is the first new titanium dioxide pigments plant to be built in the United States since 1978.

With steady growth of demand, we believe customers will be increasingly conscious of quality. We expect that this will favor Kronos because the funds spent on developing better production processes and new post-treatment technology will lead to further improvement in the high quality titanium dioxide pigments it now makes available to consumers.



Appliances

Houseware

Textiles



Paint Industry

Pulp & Paper Industries



Plastics Industry

Ceramics

Titanium dioxide pigments are used in myriad industries and many everyday products.

Computer Industry

SPECIALTY CHEMICALS

The Company's rheological additives business, operating as Rheox, is the world's largest manufacturer of rheological additives for solvent-based systems and is a significant producer of water-based systems. These products provide flow control for fluids ranging from nail polishes to industrial coatings. Rheox also provides lead/chromate-free anti-corrosive pigments.

The Company is implementing an internal restructuring, expected to be completed in mid-1990, which will result in its domestic and international specialty chemicals operations being conducted through Rheox, Inc., a wholly owned subsidiary.

Rheox was formed in 1989 to better focus resources on improving performance in the global rheological additive market. Separate functional groups, with increased marketing and technical focus, were organized as an integral part of the establishment of Rheox, Inc.

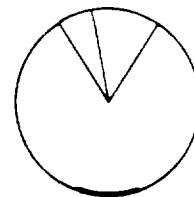
Rheox's sales, for comparable units, of \$114.1 million in 1989 declined two percent from its record breaking 1988 level. Rheox maintained its approximate 45 percent share of the worldwide rheological additives market for solvent based systems. Softer U.S. demand for rheological additives was offset by stronger international demand. Manufacturing

capacity was increased by 50 percent in the United Kingdom facility to meet this demand overseas.

Growth was substantial in the water-based market, and we believe this market will grow significantly in coming years. RHEOLATE brand associative thickeners for water-based systems have demonstrated advantages in coating formulations to competitive rheological modifiers.

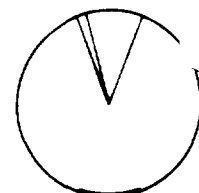
Maintaining Rheox's leadership in the rheological additives marketplace is a key objective for the next decade. We plan to introduce a diverse array of new products for the conventional solvent-based and water-based markets, and offer other products in market sectors where Rheox has not previously participated. A cornerstone to our anticipated growth will be strengthened emphasis on the RHEOLATE brand associative thickeners. We believe Rheox's water-based rheological additives technology and its dedicated technical and marketing groups should enable the Company to increase its market share in coming years. The water-based rheological additive market is slightly larger in volume than the solvent-based market sector and is growing more rapidly. Strengthening Rheox's activities outside its major markets in North America and Europe is a key component of future growth.

UNITS SOLD	UNITS RETAIRED
878	\$1.
7%	11%



SALES

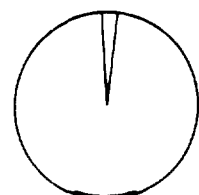
UNITS SOLD	UNITS RETAIRED
84	\$29
2%	9%



OPERATING INCOME

SPECIALTY CHEMICALS
\$45

6%



ASSETS

Specialty Chemicals As a Percent of Total NL Operations (in millions)

Paints

Caulks and Sealants

Industrial Coatings

Cosmetics Industry

Inks

Adhesives

Rheological additives
provide flow control
for a wide variety
of products.

Lubricants

**CONDENSED CONSOLIDATED STATEMENTS
OF INCOME (LOSS)**

Years ended December 31, 1989, 1988 and 1987
(In thousands, except per share data)

	1989	1988*	1987*
Net sales:			
Titanium dioxide pigments	\$ 816,874	\$ 785,460	\$653,650
Specialty chemicals:			
Comparable units	114,085	115,890	102,657
Units sold	69,924	105,686	102,960
	<u>\$1,000,883</u>	<u>\$1,007,036</u>	<u>\$859,267</u>
Operating income:			
Titanium dioxide pigments	\$ 289,349	\$ 252,569	\$176,907
Specialty chemicals:			
Comparable units	28,563	34,274	28,806
Units sold	6,226	4,437	9,195
Chemicals group expense, excluding general corporate items	<u>(15,588)</u>	<u>(7,189)</u>	<u>(5,656)</u>
	308,550	284,091	209,252
Disposition of business units	33,523	—	—
General corporate expense, net	(17,551)	(1,233)	(6,969)
Interest expense	<u>(46,433)</u>	<u>(21,751)</u>	<u>(14,854)</u>
	278,089	261,107	187,429
Provision for income taxes	(106,439)	(125,269)	(98,343)
Minority interest	<u>(1,376)</u>	<u>(1,602)</u>	<u>(1,220)</u>
Income from continuing operations	170,274	134,236	87,866
Discontinued operations	—	21,517	(107,779)
Extraordinary items	<u>2,620</u>	<u>7,220</u>	<u>—</u>
Net income (loss)	<u>\$ 172,894</u>	<u>\$ 162,973</u>	<u>\$ (19,913)</u>
Income (loss) per common share:			
Continuing operations	\$ 2.57	\$ 2.02	\$ 1.31
Discontinued operations	—	.32	(1.64)
Extraordinary items	.04	.11	—
Net income (loss)	<u>\$ 2.61</u>	<u>\$ 2.45</u>	<u>\$ (.33)</u>
Weighted average common shares outstanding	<u>66,017</u>	<u>65,879</u>	<u>65,861</u>

*Reflects the restructuring

CONDENSED CONSOLIDATED BALANCE SHEETS**1989****1988**

December 31, 1989 and 1988

(In thousands)

Current assets	\$ 586,178	\$398,960
Other assets	545,672	98,375
Property and equipment	380,465	344,020
	<u>\$1,512,315</u>	<u>\$841,355</u>
Current liabilities	\$ 647,010	\$278,453
Noncurrent liabilities	726,425	406,331
Minority interest	1,570	1,206
Series A preferred stock	5,000	10,000
Common shareholders' equity	132,310	145,365
	<u>\$1,512,315</u>	<u>\$841,355</u>
Common shares outstanding	<u>66,061</u>	<u>65,972</u>

REPORT OF INDEPENDENT ACCOUNTANTS

To the Shareholders of NL Industries, Inc.:

We have audited, in accordance with generally accepted auditing standards, the consolidated balance sheets of NL Industries, Inc. as of December 31, 1989 and 1988, and the related consolidated statements of income (loss), cash flows and Series A preferred stock, Series C preferred stock and common shareholders' equity for each of the three years in the period ended December 31, 1989 appearing in Appendix A to the proxy statement for the 1990 annual meeting of shareholders of NL Industries, Inc. (not presented herein). In our report dated February 13, 1990, also appearing in that proxy statement, we expressed an unqualified opinion on those consolidated financial statements.

In our opinion, the information set forth in the accompanying condensed consolidated financial statements is fairly presented, in all material respects, in relation to the consolidated financial statements from which it has been derived.

Houston, Texas
February 13, 1990

COOPERS & LYBRAND

**CONDENSED CONSOLIDATED STATEMENTS
OF CASH FLOWS**

1989

1988*

1987*

Years ended December 31, 1989, 1988 and 1987

(In thousands)

Cash flows from operating activities:

Net income (loss)	\$172,894	\$162,973	\$ (19,913)
Depreciation, depletion and amortization	26,458	32,011	23,936
Deferred income taxes	(9,764)	36,006	11,319
Changes in assets and liabilities	(35,917)	(11,709)	(16,541)
Other, net	(26,067)	(15,112)	149,516
Net cash provided by operating activities	<u>127,604</u>	<u>204,169</u>	<u>148,317</u>

Cash flows from investing activities:

Capital expenditures	(83,386)	(70,624)	(73,318)
Securities purchases, net	(646,381)	—	—
Other, net	102,423	(465)	2,299
Net cash used by investing activities	<u>(627,344)</u>	<u>(71,089)</u>	<u>(71,019)</u>

Cash flows from financing activities:

Borrowings, net	576,307	(38,634)	22,063
Dividends	(39,770)	(66,645)	(52,575)
Other	(5,850)	(8,758)	(4,803)
Net cash provided (used) by financing activities	<u>530,687</u>	<u>(114,037)</u>	<u>(35,315)</u>

Cash and cash equivalents:

Net increase during the year	30,947	19,043	41,983
Net change due to currency translation	(3,676)	(9,526)	7,926
Balance at beginning of year	138,367	128,850	78,941
Balance at end of year	<u>\$165,638</u>	<u>\$138,367</u>	<u>\$ 128,850</u>

Supplemental disclosures:

Cash paid for:

Interest, net of amount capitalized	\$ 34,620	\$ 17,463	\$ 15,420
Income taxes	<u>\$113,602</u>	<u>\$ 81,119</u>	<u>\$ 85,834</u>

*Excluding Baroid Corporation

**CONDENSED CONSOLIDATED STATEMENTS
OF SERIES A PREFERRED STOCK,
SERIES C PREFERRED STOCK AND
COMMON SHAREHOLDERS' EQUITY**

SERIES A PREFERRED STOCK	SERIES C PREFERRED STOCK	COMMON SHAREHOLDERS' EQUITY
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Years ended December 31, 1989, 1988 and 1987
(In thousands)

Balance at December 31, 1986	\$20,000	\$ 68,011	\$356,890
Net income (loss)	—	50,929	(70,842)
Dividends	—	(37,691)	(13,811)
Adjustment of Series C preferred stock	—	811,553	(811,553)
Currency translation adjustments, net	—	22,992	18,173
Redemption	(5,000)	—	—
Other, net	—	—	1,410
Balance at December 31, 1987	15,000	915,794	(519,733)
Net income	—	115,978	46,995
Dividends	—	(53,237)	(20,270)
Currency translation adjustments, net	—	(9,328)	(1,407)
Redemption	(5,000)	—	—
Plan of restructuring*	—	(969,050)	637,039
Other, net	—	(157)	2,741
Balance at December 31, 1988	10,000	—	145,365
Net income	—	—	172,894
Dividends	—	—	(30,599)
Currency translation adjustments, net	—	—	(86,980)
Redemption	5,000	—	—
Unrealized loss on marketable equity securities	—	—	(68,482)
Other, net	—	—	112
Balance at December 31, 1989	<u>\$ 5,000</u>	<u>\$ —</u>	<u>\$132,310</u>

*The Depositary Receipts representing the Series C preferred stock were redeemed for common stock and Baroid Corporation was spun off

**CORPORATE DIRECTORS, OFFICERS
AND EXECUTIVES**

BOARD OF DIRECTORS

J. Landis Martin
President and Chief Executive Officer

Kenneth R. Peak
Managing Director
Howard, Weil, Labouisse, Friedrichs, Inc.
(Investment banking firm)

Glenn R. Simmons
Vice Chairman
Valhi, Inc.
(Diversified holding company)

Harold C. Simmons
Chairman
NL Industries, Inc.
and Valhi, Inc.

John R. Sloan
President and Chief Executive Officer
The Thompson Company
(Private investment company)

Michael A. Snetzer
President
Valhi, Inc.

Admiral Elmo B. Zumwalt, Jr. (Retired)
Former Chief of U.S. Naval Operations

BOARD COMMITTEES

Audit Committee

Kenneth R. Peak
John R. Sloan

**Management Development and
Compensation Committee**

Kenneth R. Peak
John R. Sloan
Admiral Elmo B. Zumwalt, Jr.

**CORPORATE OFFICERS
AND EXECUTIVES**

Harold C. Simmons
Chairman

J. Landis Martin
President and Chief Executive Officer

Susan E. Alderton
Vice President and Treasurer,
NL Industries, Inc.
Kronos, Inc., and Rheox, Inc.

Jean-Pierre DeVleeschouwer
Vice President, NL Industries, Inc.
and Kronos, Inc.

David B. Garten
Vice President, Secretary, and
General Counsel, NL Industries, Inc.
and Kronos, Inc.

Dennis G. Newkirk
Vice President and Controller
NL Industries, Inc. and Kronos, Inc.

Kronos, Inc.

Dr. Lawrence A. Wigdor
President and Chief Executive Officer
Kronos, Inc., and
Chairman of the Board and
Chief Executive Officer,
Rheox, Inc.

William B. Bronner
Vice President and Secretary

Fred DeJong
Vice President, Sales and Marketing

Dr. Siegfried Hartmann
Vice President, Manufacturing

Edward J. Zadzora
Vice President, Human Resources

Rheox, Inc.

Michael J. Kenry
President and
Chief Operating Officer

Wilbert E. Blair
Vice President, Manufacturing

Michael A. DeSesa
Vice President, Technical

Paul A. Kopasko
Vice President

Thomas B. Richel
Vice President

Larry Weissman
Vice President, Marketing

Stock Symbol and Quotations

NL Industries, Inc. common stock is traded on the New York and Pacific Stock Exchanges under the symbol "NL" and its price is quoted in the daily stock tables carried by most newspapers under "NL Ind."

Annual Meeting

The annual meeting of NL Industries shareholders will be held at 1 p.m. (Central Time) on Thursday, June 28, 1990, at the Sheraton Crown Hotel in the Ballroom, 15700 John F. Kennedy Blvd., Houston, Texas.

A proxy card and proxy statement were mailed to all shareholders of record along with this annual report. Proxy cards should be signed, dated, and returned promptly to ensure that all shares are represented at the annual meeting and voted in accordance with the instruction of their owners. Shareholders are encouraged to attend the annual meeting.

Tax Reports on Dividend Income

NL Industries' dividend paying agent will report to the Internal Revenue Service (IRS) the total dividends paid to each shareholder during the preceding year. Form 1099, which contains the information supplied by the transfer agent to the IRS for each shareholder account, will be mailed to each shareholder after the end of each calendar year.

Transfer Agent

First Chicago Trust Company of New York acts as transfer agent, registrar, and dividend paying agent for the Company's stock and therefore maintains all shareholder record for the Company. All inquiries about accounts and other related matters should be directed there in writing or by telephone.

How to Make Inquiries

Telephone inquiries may be directed to First Chicago's "Telephone Response Center" at (212) 791-6422.

The telephone service is available to all shareholders Monday through Friday between 9 a.m. and 5 p.m. (Eastern Time). Written inquiries may be made to First Chicago at P.O. Box 3981, Church Street Station, New York, New York 10008-3981. Shareholders must provide their tax identification number (or Social Security number), the name(s) in which their shares are registered, and the record address when requesting information.

Dividend Payments

Dividends are declared by the Board of Directors and, if declared, are paid quarterly to the shareholder of record on the "payable date" if he or she was listed as a NL Industries shareholder on the "record date." Quarterly dividends are mailed by the dividend paying agent on the payable date. Postal service to individual shareholders may cause actual receipt dates to vary.

Lost Certificates and Lost Checks

Dividend checks are often delayed or lost when a shareholder moves and does not notify the transfer agent. Address change should be made by supplying the transfer agent with the name(s) in which the shares are registered along with the old address and the new address.

To replace lost certificates, shareholders should contact the transfer agent who will supply the necessary forms and instruments.

Form 10-K, Proxy Statement Available

Shareholders may obtain copies of both the Company's Form 10-K and Proxy Statement, which include audited financial statements, without charge. Requests for this information should be addressed to NL Industries, Inc., Investor Relations Department, P.O. Box 60087, Houston, Texas 77205, or by telephone: (713) 987-5186.

June 12, 1990

Comments on Lead Technical Support Document
and LEAD User's Guide
March, 1990 Draft

Executive Summary

The March TSD is the third draft of the Technical Support Document issued by the EPA. It incorporates many of the reviewers' comments solicited in response to the second draft of the document; however, several issues remain unclear and a calculational error has since been discovered in the LEAD program. Our comments can be generally summarized as follows:

1. We discovered a calculational error in the LEAD program which results in an overestimation of populations having blood lead levels exceeding a given target level. This overestimation is a result of an error in the calculation of lognormal probability distributions of blood lead levels in the LEAD program.
2. The appropriate input parameter for representing soil lead levels at a given site for use in the LEAD program remains unclear in the March TSD and the LEAD program User's Guide. Geometric mean soil lead levels appear to be the most appropriate input parameter given assumptions used to derive the model; however, this is not explicitly stated. EPA needs to offer guidance on this issue since maximum soil lead levels have been used in the model to recommend soil lead clean-up levels.
3. The linear relationship between soil lead and blood lead predicted by the LEAD program is inconsistent with recent findings indicating a

non-linear relationship between soil lead and blood lead. The results of these studies suggest that the LEAD program overestimates blood lead levels at soil lead levels greater than 500 ppm.

4. The LEAD program does not provide guidance on how to incorporate differences in bioavailability among different forms of lead, despite evidence to suggest that bioavailability is a function of lead speciation and particle size. Several animal feeding studies indicate that lead sulfide is less absorbed than other species. In addition, the gastrointestinal absorption equation does not adequately address the nonlinear soil lead - blood lead relationships observed in recent studies.
5. A target blood lead level of 10 - 15 $\mu\text{g}/\text{dl}$ for young children has been set without adequately distinguishing between pre-and post-natal exposure. While 6 months of age is certainly "postnatal," mobility and independence of children at this age is limited, and therefore blood lead levels at this age are likely to reflect lead exposure from resorption of lead from bone or other maternally mediated lead exposure. This argument was initially presented in our review of the October TSD and is re-presented in this report with additional comments on EPA's response to our earlier submission.

I. Introduction

In July 1989, EPA's Environmental Criteria and Assessment Office (ECAO) issued a Technical Support Document on Lead (July TSD) in which EPA proposed using the Integrated Uptake / Biokinetic (IU/BK) model as a regulatory tool for predicting blood lead concentrations in children exposed to different air lead conditions. After receiving comments on the July TSD, EPA issued a revised version in October 1989 (October TSD). At the same time as the issuance of the October TSD, an IU/BK floppy disk was also issued, thereby allowing the general public to use the program. The program is called "LEAD" and was accompanied by a User's Guide. Since that time, EPA has

received additional comments on the October TSD and issued a third draft of the Technical Support Document in March 1990 (March TSD). Gradient Corporation staff commented on the July TSD and October TSD. Additional comments on the March TSD are presented in this report.

In particular, we discovered an error in the calculation of blood lead probability distributions and the fraction of the population exceeding a target blood lead level in the LEAD program. We also have questions about the appropriate use of input parameters and the utilization of the LEAD program to determine soil lead clean-up levels. In addition, the linear relationship between soil lead and blood lead predicted by the LEAD program is inconsistent with recent investigations indicating a significant change in the soil lead-blood lead slope with increasing soil lead concentrations, especially at lower soil lead concentrations. Finally, we have several comments on uptake and bioavailability of soil lead and provide responses to EPA's comments on our previous submissions regarding effects from prenatal vs. postnatal lead exposure. Each of these specific comments are explored in the following sections of this report.

II. Blood Lead Probability Distributions

Our review of the LEAD program involved numerous independent calculations of blood lead probability distributions and predictions of populations exceeding a target blood lead level. Invariably, our predictions were lower than predictions arrived at by the model. For example, given a geometric mean blood lead level of 6.83 $\mu\text{g/dl}$ and a geometric standard deviation of 1.42, the model predicts that 7.7% of the population will exceed a target blood lead level of 12.5 $\mu\text{g/dl}$. Our calculations predict that only 4.3% of the population will exceed this same target blood lead level. Upon examining the Lotus 123 spreadsheet version of the model presented to us by Allen Marcus, we discovered that the model uses an incorrect equation for describing the population distribution of blood lead levels and thus overpredicts the fraction of a population exceeding a given target level.

The equation presented in the spreadsheet version of the model is shown below:

$$p_x(x) = \frac{1}{(2.51)(\text{GSD})} \cdot \exp \left[-1/2 \left[\frac{\ln x - \ln \text{GM}}{\ln \text{GSD}} \right]^2 \right]$$

where

- $p_X(x)$ = lognormal distribution of x
- GM = geometric mean
- GSD = geometric standard deviation
- 2.51 = $(2\pi)^{1/2}$

The correct equation for describing a lognormal population distribution is shown below (Haan, 1977):

$$p_X(x) = \frac{1}{(2.51)(x)(\ln \text{GSD})} \cdot \exp \left[-1/2 \left[\frac{\ln x - \ln \text{GM}}{\ln \text{GSD}} \right]^2 \right]$$

The authors have omitted the variable " x " and used the GSD instead of the natural log of the GSD in the denominator.

The lognormal distribution describes a population distribution where the natural log transformation of the random variable x is normally distributed. The probability density function for a normal distribution is:

$$p_X(x) = \frac{1}{(2.51)(SD_x)} \cdot e \left[-1/2 \left[\frac{x - M_x}{SD_x} \right]^2 \right]$$

where

- M_x = arithmetic mean of x variable
- SD_x = standard deviation about M_x

For a lognormal distribution, the variable y is normally distributed where $y = \ln x$. Thus the equation describing the distribution of y is:

$$p_y(y) = \frac{1}{(2.51)(SD_y)} \cdot e \left[-1/2 \left[\frac{y - M_y}{SD_y} \right]^2 \right]$$

where

$$\begin{aligned} P_y(y) &= \text{normal distribution of } y \\ M_y &= \text{arithmetic mean of } y \text{ variables} \\ SD_y &= \text{standard deviation about } M_y \end{aligned}$$

The distribution of x can be found from the following relationship given by Haan (1977):

$$p_x(x) = p_y(y) \left| dy/dx \right|$$

since $y = \ln x$

$$\left| dy/dx \right| = 1/x \quad x > 0$$

and

$$p_x(x) = \frac{1}{(2.51)(x)(SD_y)} \cdot e \left[-1/2 \left[\frac{\ln x - M_y}{SD_y} \right]^2 \right]$$

or in terms of a geometric mean and geometric standard deviation

$$\begin{aligned} SD_y &= \ln GSD \\ M_y &= \ln GM \end{aligned}$$

and

$$p_x(x) = \frac{1}{(2.51)(x)(\ln \text{GSD})} \cdot e \left[-1/2 \left[\frac{\ln x - \ln \text{GM}}{\ln \text{GSD}} \right]^2 \right]$$

Thus, the authors used an incorrect equation to describe the blood lead distribution given a geometric mean and geometric standard deviation. This calculational error also appears to exist in the LEAD program in both version 0.2 and 0.3.

III. Appropriate Use of Input Parameters

We believe EPA should clarify the appropriate use of input parameters for the LEAD program. For example, it is not clear in the March TSD or in the LEAD User's Guide whether the soil lead input parameter should be a geometric mean (GM) or arithmetic mean (AM) soil lead level. We believe GM soil lead should be the appropriate input because soil/dust lead is generally log normally distributed and because mean values should be input for models where mean values are the output. We believe EPA intends mean values as input parameters but this does need to be clarified.

On page 4-1 in the March TSD, a description of the IU/BK model indicates that the model "...yields estimates of blood lead levels associated with continuous uptakes over the lifespan." This statement suggests that mean input parameters are most appropriate for the model; however, it is not clear whether a geometric or arithmetic mean should be used. The only indication that a mean soil lead level is the appropriate input parameter is given on page 3-17 of the March TSD.

...it is important that sufficient monitoring data are collected from different local sites to produce meaningful estimates of average (mean) lead concentrations.

It is important for this issue to be clarified in the TSD and User's Guide because the LEAD program can be used to recommend soil lead clean-up levels. Use of GM, AM, or even maximum soil lead inputs in the IU/BK result in very different predicted GM blood lead levels and blood lead level distributions around the GM. If a maximum soil lead value is input into the model, for example, we believe the model will overestimate the impact of soil lead on blood lead.

To illustrate the significance of the choice of soil lead input, we use the following illustration. If a soil lead clean-up level is designated as 600 ppm, this means the maximum allowable soil lead, or 100% level, is 600 ppm. An input of a maximum soil lead value into IU/BK, however, does not translate to a GM blood lead level if IU/BK is meant to predict GM blood lead based on mean input parameters. If mean input parameters are indeed appropriate for the IU/BK, then the maximum soil lead cleanup level of 600 ppm is really 265 ppm as a geometric mean (assuming 1.42 GSD). Likewise, if 600 ppm is instead taken as a GM soil lead, the actual maximum (or 99%) soil lead cleanup level would be 1,358 ppm. This clean-up level is more than two times higher than if the 600 ppm level is interpreted as the maximum soil lead level.

Due to the potential for misuse of the model and magnitude of the difference in soil lead clean-up level estimates, we recommend that EPA clarify their position on appropriate soil lead input parameters.

IV. Soil Lead-Blood Lead Relationships

The LEAD program predicts a nearly linear relationship between blood lead levels and soil lead concentrations. Although the Program recognizes some nonlinear biokinetic relationships, e.g. decreasing absorption of lead with increasing lead concentration (p. 4-11) and decreasing blood compartment burdens with increasing uptake (p.4-21), these do not create a significant deviation from linearity in the soil lead-blood lead relationship. Recent investigations of blood lead and soil lead in Cincinnati, OH (an urban area), Telluride, CO (a former mining community) and Midvale, UT (a former milling and smelting community) (Bornschein et al. 1988, 1990), however, show a significant change in the soil lead-blood lead slope with increasing soil lead concentrations, especially at lower soil lead concentrations.

Figure 1 compares Bornschein et al.'s predictions of blood lead as a function of soil lead at Cincinnati, Telluride, and Midvale to the blood lead predictions by LEAD. The Bornschein et al. curves in this figure are based on blood lead and environmental data collected in these communities. The equations describing these curves were derived from multiple regression analysis of the various variables found to influence blood lead levels (e.g., hand lead content, number of cigarettes smoked, socioeconomic status). Average values for these variables were used in drawing the curves. The

LEAD predicted curve was drawn assuming default values for all parameters with the exception of housedust lead concentrations which were assumed equal to soil lead levels.

The graphic comparison in Figure 1 clearly shows that the slopes of the Bornscheim curves gradually decrease as the surface soil lead concentration increases, while the LEAD Program slope remains constant. This results in a significant overestimation of blood lead concentrations by the LEAD program at higher soil lead concentrations.

V. Bioavailability of Soil Lead in the Gastrointestinal Tract

The LEAD program offers either a linear or a nonlinear, active-passive model to estimate uptake of soil lead from the gastrointestinal (GI) tract. The active-passive model is as follows:

$$A_{DS} = A_{DSP} + (A_{DSA}/(1+([Pb]_{GI}/K_m)^3))$$

where

A_{DS}	=	absorption coefficient for dust-soil lead
A_{DSP}	=	coefficient for nonsaturable (passive) absorption
A_{DSA}	=	coefficient for saturable (active) absorption
$[Pb]_{GI}$	=	concentration of dust-soil lead in the gastrointestinal tract ($\mu g/l$)
K_m	=	apparent K_m for saturable absorption ($\mu g/l$)

and the default values for a 2-3 year old are:

A_{DS}	=	0.3 for the default dust-soil lead intake of 20 $\mu g/day$
A_{DSP}	=	0.15
A_{DSA}	=	0.15 for the dust-soil lead intake of 20 $\mu g/day$
$[Pb]_{GI}$	=	6 $\mu g/l$ for the default dust-soil lead intake of 20 $\mu g/day$
K_m	=	100 $\mu g/l$

The basis for this equation is not provided although it is stated that the active-passive equation will be equivalent to the linear model at concentrations less than the K_m value of 100 $\mu\text{g/l}$.

While it is difficult to comment on the equation without the supporting documentation, several technical difficulties are apparent with the model even in the absence of the supporting material.

1. The equation does not consider bioavailability differences among different forms of lead. The work of several researchers suggests bioavailability is a function of lead species and that lead sulfide, in particular, is less well absorbed than other forms of lead. Barltrop and Meek (1975) examined the absorption of 12 different lead compounds relative to lead acetate absorption. Young rats were fed a diet containing 0.075% of the indicated lead compound for 48 hr. At the end of this period, the rats were sacrificed, and the lead content of blood, femur, and kidney was determined. The absorption of metallic lead (particle size of 180-150 μm) was lower than the absorption of lead salts (particle sizes $<50 \mu\text{m}$). Of all compounds, lead carbonate had the highest absorption which the authors suggest may reflect the greater solubility of this compound in gastric juice. Absorption of lead sulfide and lead chromate was significantly less than that of lead acetate, while the other lead species (including lead oxides) had absorptions similar to that of lead acetate.

Other animal studies also indicate that lead sulfide may be less absorbed than other lead species. In one study, calves were fed lead in the form of phosphate, oxide, basic carbonate, and sulfide (Allcroft, 1950). The authors found lead sulfide to be "less toxic," as defined by lower kidney and blood lead levels and greater survival rates. In another study, guinea pigs were fed (in a flour vehicle) various lead compounds (Fairhall and Sayers, 1940). Lead sulfide ingestion generally resulted in less absorption (as measured by liver, kidney, and bone contents) compared to lead oxides and sulfates.

2. The equation does not consider differences in pH throughout the tract. The role of pH can be very important in the solubilization of certain forms of lead. Several researchers observed a decrease in the solubility of lead from street dust with increasing pH (Day et al., 1979; Harrison, 1979; Duggan and Williams, 1977). In addition, ionic constituents throughout the

GI tract will also influence solubility and uptake. Thus, the dietary absorption equation may be too simplistic to reflect the factors that modify lead uptake from soil.

3. As noted above (Section 3.0), epidemiological studies at Cincinnati, OH, Telluride, CO, and Midvale, UT show non-linearities between soil lead and blood lead. These results indicate reduced bioavailability at higher soil lead concentrations. The bioavailability value can be back-calculated based on slopes, an assumed soil ingestion rate (90 mg/day), and the biokinetic slope factor in the LEAD program.

Specifically, at Telluride, CO, the following structural equation was developed to calculate blood lead levels (Bornschein et al., 1988):

$$\begin{aligned} \ln (\text{PbB}) &= -0.545 + 0.494 \ln(\text{PbH}) + 0.128(\text{Age}) - 0.140 (\ln\text{PbH} \times \text{Age}) \\ &\quad + 0.347 \ln (\text{PbD}) \\ \ln (\text{PbH}) &= -1.582 + 0.218 (\text{Age}) + 0.420 \ln (\text{PbD}) \\ \ln (\text{PbD}) &= 3.573 + 0.400 \ln (\text{PbSS}) \end{aligned}$$

Where

- PbB = blood lead concentration (ppm)
- PbH = lead concentration on hands (ppm)
- Age = child's age (years)
- PbD = lead concentration in housedust (ppm)
- PbSS = lead concentration in surface soil (ppm)

Using these equations, a slope of 6.4 $\mu\text{g}/\text{dl}$ per 1,000 ppm soil lead was calculated for 18 month old children exposed to soil lead concentrations between 50 and 500 ppm and a slope of 2.2 $\mu\text{g}/\text{dl}$ per 1,000 ppm soil lead was calculated for 18 months old children exposed to between 500 and 1,000 ppm lead in soil. Assuming a soil ingestion rate of 90 mg/day and a biokinetic slope factor of 0.288, slopes of 6.4 and 2.2 correspond to a lead in soil bioavailability of 24.7% and 8.5%, respectively. In contrast, using only geometric mean soil/housedust lead concentration (167 ppm) and blood lead values (6.3 $\mu\text{g}/\text{dl}$) with soil ingestion rate of 90 mg/day and a background blood lead level of 4.8 $\mu\text{g}/\text{dl}$ yielded a

bioavailability of 33.0%. While the LEAD absorption model does address non-linearities, it is insufficient to account for such large differences at different soil lead concentrations.

The reason for the non-linearity between soil lead and blood lead is not known, but it could reflect solubility limits of certain forms of leads in the GI tract. For example, in a feeding study in which different concentrations of lead acetate were mixed with soil and fed to rats (Chaney, 1989), the percent bioavailability increased as lead acetate concentration increased. Discrepancy between the feeding study and the epidemiological studies may be due to the lead species and type of matrix (i.e. chemical microenvironment) in which the lead is present.

We propose two approaches to improve the absorption equation:

1. Additional calibration efforts should be conducted using epidemiological data and default parameters changed to reflect the nonlinearities. Conceivably a power function relationship could be used.
2. Physical/chemical characterization studies should be performed on soil samples from epidemiological studies. It may be possible to develop an in vitro leaching system in which the leachability of a sample could be correlated with a bioavailability estimate based on blood lead: soil lead relationships developed from the epidemiology study.

VI. Target Blood Lead Levels

With respect to EPA's response to our previous comments on the distinction between dose-response relationships for postnatal and prenatal exposure, we believe this issue warrants further consideration. In particular, the evidence that supports different effect levels for postnatal and prenatal exposure should be reconsidered.

In their evaluation of studies on the neurological effects from lead exposure, EPA should give special consideration to the timing of lead exposure and blood lead measurements in relation to measurements of cognitive deficit. In the TSD, the section on the mental development in infants and

children (Section 2.4.1) frequently ignores timing of exposure, focusing only on magnitude of exposure and subsequent effects. If the EPA were to more clearly define the ages at which blood lead values were indicative of prenatal vs. postnatal exposure, their discussion of the importance of various effects would become clear. For example, in the TSD, the EPA uses 6 month PbB values to evaluate effects from postnatal exposure. While chronologically this age is certainly "postnatal," mobility and independence of children at this age is limited, and therefore blood lead levels at this age are likely to reflect lead exposure from resorption of lead from bone or other maternally-mediated lead exposure rather than reflecting exposures from the child's independent activities (i.e. soil exposure and ingestion) (Bellinger et al., 1987).

Section 2.4.1 of the TSD considers the correlation of lead exposure with neurological deficits in early childhood. In this section, the TSD correctly states that, "All these studies taken together suggest that neurobehavioral deficits...are associated with prenatal blood lead exposures levels on the order of 10-15 $\mu\text{g}/\text{dl}$ ". In the following review and summary of the studies that are presented, however, discrimination between prenatal and postnatal exposure and the corresponding evaluation of mental deficit becomes less clear.

For example, in the discussion of studies conducted in Cincinnati, all correlations between decrements in cognitive development and blood lead levels are for prenatal exposures (prenatal, cord or 10-day blood lead measurements). This is clearly presented in the summary, yet the TSD generalizes these prenatal results to children of all ages, concluding from the Cincinnati studies that the decrements associated with prenatal or neonatal blood lead levels of 25 $\mu\text{g}/\text{dl}$ supports selection of 10-15 $\mu\text{g}/\text{dl}$ as a range of concern for effects in "children" (age unspecified), when no data have been presented regarding blood lead levels in older (10 days) children. Similarly, in the discussion of the Cleveland study, all decrements in mental development that were measured were associated with prenatal lead exposure (cord lead levels, maternal blood lead, or 6 month blood lead). Conclusions from this research, however, are that postnatal mental development is related to "blood lead levels below 15 $\mu\text{g}/\text{dl}$," (TSD, p. 2-41) again, with no indication that the measured effects were associated with prenatal and not postnatal exposures.

The Port Pirie study is the only study that provides a thorough analysis of possible effects of childhood (i.e., postnatal) exposure and mental development. Findings of this study include mean

blood lead at age 6 months were on the order of 20+ $\mu\text{g}/\text{dl}$, and that at age 4, cumulative PbB is the most important determinant of adverse effects. While these results are correctly described in the TSD, terminology used in concluding sentence obfuscates the meaning. Specifically, the TSD states that "...an increase in integrated postnatal blood lead level from 10-30 $\mu\text{g}/\text{dl}$ was associated with a 7-point decrease in GCI score." Initial reading of this could bring the reader to infer that postnatal blood lead levels above 10 $\mu\text{g}/\text{dl}$ were associated with GCI decrements, when it should be properly interpreted to mean that children with blood lead values of 30 $\mu\text{g}/\text{dl}$ experienced a significantly lower GCI score (7 points lower) when compared to children with blood lead values of 10 $\mu\text{g}/\text{dl}$. That this study detected developmental deficits with integrated postnatal blood lead values of 20-30 $\mu\text{g}/\text{dl}$ is consistent with a blood lead level of concern in young children in the range of 20-25 $\mu\text{g}/\text{dl}$.

EPA's response to our comments reflects a blurred distinction between mental decrements and the period of lead exposures. In its response, the Agency cites the correlation between 6-month blood lead of 15 $\mu\text{g}/\text{dl}$ and MDI scores as evidence of postnatal exposure effects. As discussed above, however, blood lead values at 6 months of age are likely to reflect maternally-mediated exposures rather than direct exposures to contaminated soils. In the response, the Agency also states that the Boston study provides no information about effects from postnatal exposures in the range of 10-15 $\mu\text{g}/\text{dl}$ since postnatal blood lead values did not exceed 8 $\mu\text{g}/\text{dl}$. In fact, mean postnatal blood lead levels did not exceed 8 $\mu\text{g}/\text{dl}$, but the high exposure group still consisted of children with blood lead values in excess of 10 $\mu\text{g}/\text{dl}$.

The research by Schroeder (1989), showing the correlation between deficits in mental development and postnatal exposure (age 10 mo. - 6.5 yr) is consistent with findings in Port Pirie, as the blood lead levels in these individuals (21 $\mu\text{g}/\text{dl}$ mean) is clearly higher than in many of the studies on effects from prenatal exposure.

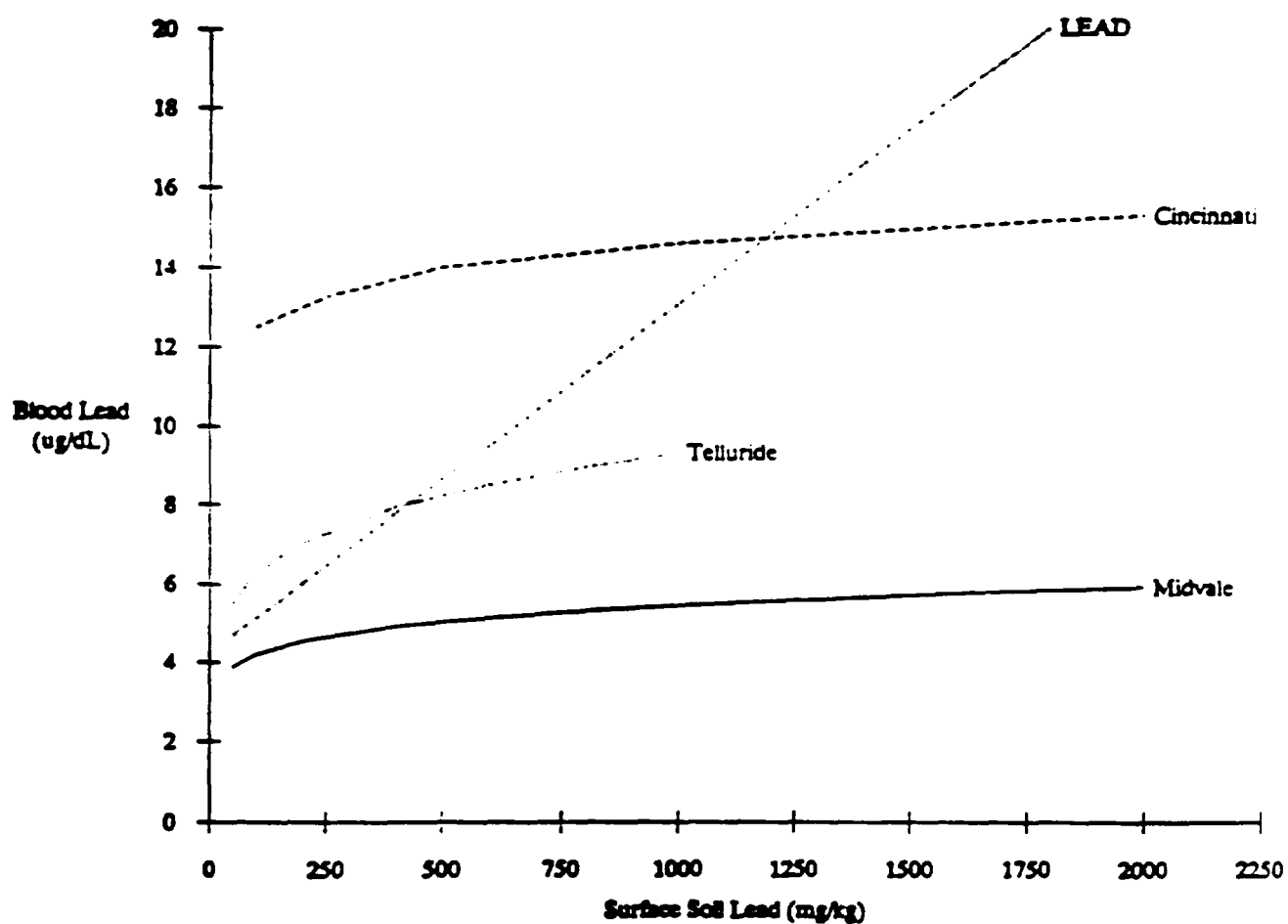
In regard to the findings by Raab et al. (1989), this reference is neither provided nor discussed in Section 2.4.1 of the TSD (Mental Development in Infants & Children).

In general, the EPA's response to our comment does not address the issue that we are presenting. Specifically, the EPA fails to distinguish between the dose-response relationship for postnatal vs. prenatal exposure. This most likely occurs due to the failure of the EPA to adequately track the

timing of lead exposure in their evaluation of the blood lead concentrations that result in effects on —
mental development.

Figure 1.

Comparison of Predicted Blood Lead Levels for
2 Year Old Children



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Comments on the ROD and the Scope of Work Taracorp Superfund Site, Granite City, Illinois

1. Additional deep monitoring wells

The requirement that four new wells be installed in the deeper portion of the upper aquifer to monitor ground water conditions upgradient and downgradient of the waste pile suggests that EPA intends that these wells be used in a long term monitoring plan. At present, there is no evidence to suggest that the deeper portions of this aquifer are contaminated; therefore, implementation of a comprehensive monitoring program is premature. An investigatory well should be installed and sampled before a monitoring program is required. The possibility that installation of deep wells will result in inadvertent contamination of the deeper portion of the aquifer must be considered in deciding whether a monitoring system is necessary. Expansion of the Taracorp waste pile will have a significant effect on the local hydrology, and may also restrict the placement of new monitoring wells. Therefore, the final design of the monitoring system (if a system is required) should be developed after the expansion is complete and effects on the local hydrology have been evaluated.

2. Monitoring of ground water for organic contaminants

There is no evidence that organic contaminants are associated with the Taracorp waste pile, and no justification for adding them to the list of analytes has been provided. Experience suggests that the probability of false positive results is quite high in sampling and analyzing for some organic contaminants. The cost of these analyses can also be considerable. In the absence of any evidence of the presence of these organic contaminants, the list of parameters to be monitored should be restricted to gross indicators and those contaminants previously detected in the waste materials or ground water.

3. Installation of a clay liner under newly-created portions of the Taracorp pile, preceded by removal of Area 1 soils with lead concentrations in excess of 1000 ppm

This liner should not be necessary; nor should excavation of the Area I soils that will be covered by the expanded pile. The expanded waste pile will be constructed with a cap designed to minimize infiltration, and most of the material placed in the expanded

pile will be soil excavated from the residential areas. If this material is placed and capped correctly, the amount of leachate generated in the expanded pile will be minimal. Thus, there is also no need to excavate the surface soils in the portions of Area 1 that will be covered by the expanded pile.

4. Toxicity testing of materials to be added to the Taracorp pile

Toxicity testing of materials to be added to the pile is not warranted by the evidence collected in the RI/FS process. The majority of the material to be added to the pile is expected to be soil from the residential areas. As reported in the RI, a soil sample containing one of the highest concentrations of lead (3110 ppm) was subjected to the EP toxicity test, and passed. Even if some portion of the material added to the pile releases lead at a rate greater than allowed by the EP toxicity test, the leachate (if any) generated from this portion would be diluted by leachate from the less contaminated portions.

5. Air monitoring: PM10 and lead

After remediation, there will not be any uncontrolled source of contaminated particulates at the Taracorp site. Taracorp is not operating the smelter, the affected surface soils will have been replaced with clean soil, and the cap will prevent generation of contaminated particles from the waste pile. Given the industrial nature of the surrounding area, it is possible that established levels of airborne contaminants will be exceeded due to activities that are in no way associated with the Taracorp site. It is not reasonable to require the PRPs to perform this air monitoring when the only likely sources of contaminants are not related to their activities.

6. Expansion of the battery case material inspection area

The area to be inspected for battery case material should not be expanded beyond Venice and Eagle Park Acres to all nearby communities in the absence of evidence that the Taracorp site was the source of the material.

7. Cleanup of case materials and surrounding soils to 500 ppm

The basis for the 500 ppm cleanup level has not been scientifically established in the administrative record. A decision on criteria for soil cleanup cannot be made until additional scientific studies are conducted.

8. Maximum required depth of remediation

A maximum required depth of remediation should be established for the

residential soils. This maximum depth should be selected after consideration of the health risks posed by the presence of lead at various depths. Although lead in surface soils may contribute to health risks through ingestion and inhalation of soil and household dust particles, children are unlikely to be exposed to contamination at deeper levels in the soil column. The uncertainty associated with the maximum depth of sampling and remediation makes it impossible to develop reasonably accurate estimates of the total costs of implementation. Therefore, the cost-effectiveness of the various alternatives cannot be compared until the required depth of excavation has been established.

9. Responsibility for sampling and removing soils that are currently capped by asphalt or other barriers if these soils become exposed in the future

There is no evidence that soils that are currently capped by pavement or buildings will pose a public health threat if they are uncapped in the future. The soil depth of concern will be defined during implementation of the remedial action; until this has been determined, sampling of soils exposed by excavation or deterioration of pavements should not be required. In the future, the nature and purpose of each excavation, paving, or construction activity will determine the potential exposure to soils that are currently capped and should also determine the need for sampling and soil removal.

10. EPA's Application of the Integrated Uptake/Biokinetic MODEL

EPA has applied the Integrated Uptake/Biokinetic (IU/BK) Model, in the form of the LEAD program, to predict the mean blood lead level and distribution among children ages 0-6 years who are exposed to soil and dust levels of 500 ppm or 1000 ppm at the NL/Taracorp Site. The results of this model may be taken into account in setting clean-up levels, provided that (1) site-specific and up-to-date parameters are used in the model, and (2) a sound, scientific basis is developed for the target blood lead level, the target population, and the percentage of the population to be protected. EPA has not met these criteria in its application of the IU/BK model to set clean-up levels at the Taracorp site.

A. Inadequate Justification for the 15 $\mu\text{g}/\text{dL}$ Target Blood Lead Level for Young Children

In its application of the IU/BK model to set soil clean-up levels at the NL/Taracorp site, EPA has inadequately justified its selection of 15 $\mu\text{g}/\text{dL}$ as the target blood lead level for young children. The selection appears to be based primarily upon neurobehavioral effects in young children. EPA states that

Needleman (1988) "emphasizes that careful epidemiologic studies, which have controlled for the important confounders, have set the level for these effects at 10-15 micrograms per deciliter lead in blood". It is important to note, however, that the recent epidemiologic studies have suggested that neurobehavioral effects have been associated only with prenatal blood lead levels (i.e. maternal blood lead levels) in the range of 15 $\mu\text{g}/\text{dL}$, while this association at low blood lead levels has not been established for postnatal exposure.

B. Use of The LEAD Program in Which a Calculational Error Has Been Noted

The LEAD computer program used by EPA to evaluate the effects of possible clean-up actions at this site contains an erroneous formula. For any specified exposure scenario, the program overestimates the actual percentage of the population that would be expected to have high blood lead levels. Therefore, EPA has underestimated the true proportion of the population that would be protected by its proposed remedial action. See the attached comments submitted to EPA by Gradient Corporation.

11. Blood Lead Study

The consent decree indicates that blood lead sampling should be performed to "provide the community with current data on potential acute health effects associated with site contamination". We are in agreement with the utility of performing blood lead sampling and analysis to assess current lead uptake in residents at the site. It is essential, however, that the blood lead sampling be performed in conjunction with soil sampling in order that the association between blood lead and soil lead contamination can be established. Knowledge of this association is necessary in order to determine the appropriate site-specific clean-up criteria and to assess the impact that any remediation would have upon blood lead levels. In order to assure that the blood lead/soil lead association is firmly established, it is important that the overall blood lead study involve a representative random sample of the population, of adequate size to characterize that geometric mean and range of blood lead levels and the degree of soil lead contamination in the area. By measuring a random sample, observations about the mean and distribution of blood lead levels and soil levels can be extrapolated to all individuals in the study area.

ADDITIONAL COMMENTS ON RECORD OF DECISION

Pg. 1, Para last	Delete reference to "any other nearby communities. . ."
Pg. 2, Para 3rd	Recycle at secondary lead smelter if possible and material is acceptable. (60% lead content is present minimum).
Pg. 1, Para II #3	Note that Taracorp was the only recipient of an AOC that actually complied with the Order. Tri-City Trucking and Stackorp were not recipients of the Special Notice Letter (122e).
Pg. 2, Para II #4	Date for placement on the NPL does not agree with the Draft Consent Decree.
Pg. 2, Para III	240 people out of 40,000 population does not represent "extensive community interest."
Pg. 4, Para #1	<u>Area 1</u> Trust 454 and Tri-City Trucking properties were recipients of EPA enforcement orders in 1984 to address sources of lead contamination. However, the requirements of the order were never fulfilled. Since these properties were identified as sources in the IEPA - SIP for lead in 1984, they should be included as PRP's in this action, as well as Stackorp.
Pg. 5, Para #2	<u>Surface Water and Air</u> St. Louis Lead Recyclers also ceased work on the Taracorp pile in 1983.
Pg. 5, Para	<u>Post RI Information and Inspections</u> The agency should provide information regarding additional areas identified.
Pg. 16, Para	<u>Short Term Effectives - Tables</u> The estimated time for completion of 2 1/2 years for Alternative H is, based upon OBG estimates, incorrect. Alternative H would require approximately 7 1/2 years to complete.

Pg. 16, Para

Cost

As noted above, Pg. 13, Para 2, the EPA acknowledged that cost estimates have not been developed for the 5 additional work areas, therefore this comparison is flawed by their own acknowledgment. Further, as identified by OBG during the public comment period, the EPA cost estimate for Alternative H was incorrect. (i.e., only counted on half of residences in response areas and had a mathematical error of approximately 30%).

Pg. 16, Para

Community Acceptance

A review of the synopsis of the public comments (attached to the ROD) failed to identify a public comment regarding the "construction of a clay liner" under the Taracorp pile expansion, or the contingency measure for soils disturbed in the future.

ADDITIONAL COMMENTS ON SCOPE OF WORK

Pg. 1, Para

Soil Sampling/Inspection (1st Para)

Delete "but is not" limited to . . ."
This is poor definition - open ended -
needs clarification.

Pg. 2, Para

Alleys and Driveways

In last sentence delete "and paved." Add
"and resurfaced in a manner consistent with
original conditions, or present usage."

Rod - Figure 8

Multi-Media Cap Detail

RCRA Cap is not necessary. Change Cap to
eliminate substantial maintenance problems.
(i.e., Use membrane, fabric, Tensar and 2"
Crushed stone.

June 20, 1990

Chris DeRosa, Ph.D.
U.S. EPA OHEA
Env. Crit. and Assessment Office
26 West M.L. King St.
Cincinnati, OH 45268

Subject: Comments on March 1990 TSD and LEAD 0.3

Dear Dr. DeRosa:

Enclosed please find comments we have prepared on the third draft of the Technical Support Document (TSD) for lead, the LEAD Users' Guide, and LEAD 0.3 software. The March TSD reflects many of the reviewer's comments solicited in response to the second draft of the document; however, several issues remain unclear and we believe there is a calculational error in the LEAD program.

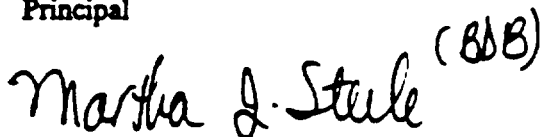
Please do not hesitate to contact either one of us if there are any questions. Thank you for your consideration.

Sincerely yours,

GRADIENT CORPORATION



Barbara D. Beck, Ph.D., DABT
Principal



Martha J. Steele, M.P.H.
Senior Associate

T9

1620h19.052

Scope of Work

Taracorp Superfund Site, Granite City, Illinois

I. Introduction

This document constitutes the Scope of Work for the "Good Faith Offer" outlined in EPA's "Interim Guidance on Notice Letters, Negotiations, and Information Exchange" for the Taracorp Superfund site in Granite City, Illinois.

II. Objectives

The overall goals of this Scope of Work are to:

1. establish the relationship between blood lead levels of residents in the study area and residential soil contamination;
2. develop a plan for a risk assessment for the site that is acceptable to the U.S. Environmental Protection Agency, and implement the plan, if deemed appropriate by the U.S. Environmental Protection Agency; and
3. define the appropriate criteria for soil cleanup at the site.

The information obtained from these studies will be used to establish the specific parameters of the Remedial Design/Remedial Action (RD/RA).

III. Contents of the Scope of Work

The Scope of Work consists of thirteen tasks. A performance schedule, with time estimates for each task, is attached. Overall project management will be provided by the Potentially Responsible Parties who have signed the Good Faith Offer. Progress reports will be submitted to EPA at the completion of each task. The following tasks will be performed:

1. Conduct a demographic survey of the population of Granite City

A household census will be conducted in the Granite City community to provide a sampling framework for a blood lead study. This census will be sufficiently detailed to allow selection of a representative sample of high-risk individuals from the Granite City population.

2. Conduct a blood lead study of the Granite City population

A study will be performed to determine the blood lead levels of a representative sample of all Granite City residents from 6 months to 6 years of age, and of all female residents who are either pregnant or nursing their babies. Measurements of the blood lead and FEP of each subject will be obtained. Soil samples will be collected from the yards of the study subjects' residences and analyzed for lead content.

3. Inspect the homes of the study subjects to identify possible sources of lead exposure

In conjunction with the blood lead study, the homes of the study subjects will be visually inspected. In addition, portable X-ray fluorescence (XRF) equipment will be used to determine the presence of lead in house paint.

4. Determine the distribution of lead-bearing soils in Granite City

Soil samples will be collected and analyzed for lead to allow estimation of the necessary depth and areal extent of excavation, and of the total volume of soils to be excavated. Where possible, sample collection in the residential areas of Granite City will be coordinated with the soil sampling portion of Task 2. A separate sampling protocol, to include testing for EP toxicity, will be developed for Area 1.

5. As an extension of tasks 1 through 4 above, develop a plan for a risk assessment for the site that is acceptable to the U.S. Environmental Protection Agency, and implement the plan, if deemed appropriate by the U.S. Environmental Protection Agency

A plan will be developed for assessing the potential risks to human health associated with lead in the soils of Granite City. The level and distribution of lead

in these soils will be determined in task 4. The impact of lead in soils on human health will be inferred from the results of tasks 1 through 3.

6. Develop a system for monitoring the deep groundwater

A plan for monitoring the quality of the deep groundwater will be developed and any necessary additional wells will be installed.

7. Inspect driveways and alleys in selected neighborhoods for battery casing materials

As noted in the Record of Decision, driveways and alleys in the communities of Venice and Eagle Park Acres will be inspected to identify areas of buried battery case materials supplied by the Taracorp smelter. Where case materials from the smelter are found, appropriate sampling and analysis will be conducted and, if necessary, a recommendation for treatment or disposal will be made.

8. Recycle the drums from the Taracorp pile

The contents of the drums will be recycled, if possible.

9. Consolidate the SLLR waste pile and the Taracorp pile

Consolidation of the SLLR waste pile with the Taracorp pile will be accomplished in the most environmentally sound manner.

10. Perform a treatability study of the battery casing material

The fact that the battery casing materials are mixed with soil and rock will complicate the selection of an appropriate treatment process. A treatability study for this material will be furnished.

11. Design a cap for the expanded Taracorp pile

This cap will be designed after the soil sampling has been performed, so that a reliable estimate of the total volume of material to be covered will be available. The cap will be designed to minimize the dispersion of particulate matter and

infiltration of water into the capped materials.

- 12. Develop environmental contingency plans for actions to be taken in the event that air or ground water is found to be contaminated by the site in the future**

These contingency plans will outline the recommended remedial actions to be taken if future monitoring data indicate that ground water or air is being contaminated by releases from the Taracorp site. These plans will include protocols for evaluating future monitoring data to determine if an applicable standard has been exceeded. Specific actions for mitigating any future releases will be outlined and accompanied by an evaluation of the effectiveness of each action.

- 13. Develop a dust control plan for use during all remedial construction activities to mitigate the release of contaminated soils**

This plan will outline precautionary measures to minimize fugitive dust emissions during excavation in the study area and the transfer of contaminated material and soils to the Taracorp Pile.

**Schedule of Performance for the Scope of Work
Taracorp Superfund Site, Granite City, Illinois**

Task 1: Demographic Study

- | | |
|----------------------------------|---------------|
| a) study design (2 weeks) | Spring 1991 |
| b) door-to-door survey (6 weeks) | May-June 1991 |
| c) tabulation of data (4 weeks) | July 1991 |

Task 2: Blood Lead Study

- | | |
|---|-------------------|
| a) subject selection (2 weeks) | July 1991 |
| b) permission forms and sample collection (8 weeks) | Aug-Sept 1991 |
| d) laboratory analyses (8 weeks) | Oct-Nov 1991 |
| e) data interpretation (10 weeks) | Dec 1991-Feb 1992 |
| f) report preparation (12 weeks) | Jan-March 1992 |

Task 3: Home Inspections for Blood Lead Study Subjects

- | | |
|--|---------------|
| to coincide with blood and surface soil sampling (8 weeks) | Aug-Sept 1991 |
|--|---------------|

Task 4: Determine the Distribution of Lead-Bearing Soils

- | | |
|---|---------------|
| a) sampling plan and protocols (8 weeks) | Spring 1991 |
| b) permission forms, equipment purchase, training (4 weeks) | July 1991 |
| c) sample acquisition (6 weeks) | Aug-Sept 1991 |
| d) laboratory analysis (8 weeks) | Sept-Oct 1991 |
| e) data analysis and report preparation (8 weeks) | Nov-Dec 1991 |

Task 5: Assess Potential Risks Associated with Lead in Soils

- | | |
|--|------------------|
| a) develop a plan to assess risk (4 weeks) | Fall 1990 |
| b) implement the plan (8 weeks) | to be determined |

Task 6: Develop a Groundwater Monitoring System

- | | |
|--|------------------|
| a) develop a plan after final design of
the expanded waste pile (4 weeks) | Summer/Fall 1992 |
| b) install additional deep wells (4 weeks) | Summer/Fall 1992 |

Task 7: Inspect Driveways and Alleys

- | | |
|--|-------------|
| a) visual inspection and sample collection (4 weeks) | Fall 1990 |
| b) EP Toxicity analysis (4 weeks) | Fall 1990 |
| c) report preparation (4 weeks) | Winter 1990 |

Task 8: Recycling of Drums from the Taracorp Pile

Fall 1990

Task 9: Consolidation of the SLLR and Taracorp Piles

- | | |
|---|-----------|
| in conjunction with excavation of residential soils (4 weeks) | Fall 1992 |
|---|-----------|

Task 10: Treatability Study of Battery Casing Material

Fall 1990

Task 11: Design of a Cap for the Expanded Taracorp Pile

- | | |
|---|-------------|
| after determination of total volume of
the expanded waste pile (6 weeks) | Summer 1992 |
|---|-------------|

Task 12: Development of Environmental Contingency Plans

- | | |
|---|-----------|
| a) first drafts (6 weeks) | Fall 1990 |
| b) revision for final site conditions (4 weeks) | Fall 1992 |

Task 13: Dust Control Plan

- | | |
|--|-----------|
| a) first draft (2 weeks) | Fall 1990 |
| b) revision for final remediation plan (2 weeks) | Fall 1992 |

8/27/90

3957J/3957J.001 [3957J]/0035X

NL SUBMITTAL
REVISED DRAFT ADDITIONS ARE UNDERLINED;
DELETIONS ARE INDICATED IN BRACKETS

ATTACHMENT III
DRAFT CONSENT DECREE
NL INDUSTRIES/TARACORP SITE
GRANITE CITY, ILLINOIS

UNITED STATES OF AMERICA,
STATE OF ILLINOIS

Plaintiffs,

v.

[NL INDUSTRIES] TARACORP,
INC., et al.,

Defendants.

CONSENT DECREE

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CONSENT DECREE

WHEREAS, [The] the United States Environmental Protection Agency ("U.S. EPA"), pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA"), 42 U.S.C. § 9605, placed the [NL Industries/Taracorp] NL/Taracorp Site in Granite City, Illinois [(the "Facility" as specifically defined in Paragraph 4 of this Consent Decree)] on the National Priorities List, which is set forth at 40 CFR Part 300, Appendix B, by publication in the Federal Register on October 15, 1984, 49 Fed. Reg. [4032Q] 4032 (1984);

[In response to a release or a substantial threat of a release of a hazardous substance at or from the Facility,] U.S. EPA signed an Administrative Order By Consent with NL Industries, Inc. on March 11, 1985, to conduct a Remedial Investigation and Feasibility Study (" [RIFS] RI/FS") pursuant to 40 [CFR] C.F.R. § 300.68 for the Facility;

NL Industries completed a Draft Remedial Investigation ("RI") Report in September, 1988[.], and U.S. EPA accepted the draft report with modifications on January 10, 1989. NL Industries completed a Draft Feasibility Study ("FS") Report in August, 1989. The Draft FS Report was modified by U.S. EPA and released to the public [by] with U.S. [EPA, with] EPA's modifications, on January 10, 1990.

On or about January 10, 1990, U.S. EPA, pursuant to Section 117 of CERCLA, 42 U.S.C. § 9617, published notice of the completion of the [RIFS] RI/FS and of the proposed plan for remedial action, in a major local newspaper of general circulation and provided opportunity for public comment to be submitted in writing to U.S. EPA by February 24, 1990, or orally at a public meeting held in Granite City, Illinois, on February 8, 1990. U.S. EPA subsequently agreed to accept written public comments until March 12, 1990.

U.S. EPA, pursuant to Section 117 of CERCLA, 42 U.S.C. § 9617, has kept a transcript of the public meeting and has made this transcript available to the public as part of the administrative record located at U.S. EPA, Region V, 230 South Dearborn Street, Chicago, Illinois and at the Granite City Public Library, 2001 Delmar Avenue, Granite City, [IL] Illinois 62040.

On or about November 28, 1989 [or] and April 9, 1990, U.S. EPA, pursuant to Section 122 of CERCLA, 42 U.S.C. § 9622, notified certain parties that the U.S. EPA had determined [each party] such parties to be [a] potentially responsible [party] parties (" [PRP"] PRPs") regarding the proposed remedial action at the Facility;

In accordance with Section 121(f)(1)(F) of CERCLA, 42 U.S.C. § 9621(f)(1)(F), U.S. EPA notified the State of Illinois on _____, 1990 of negotiations with PRPs regarding

the scope of the remedial design and remedial action for the Facility, and U.S. EPA has provided the State with an opportunity to participate in such negotiations and be a party to any settlement;

Pursuant to Section 122(j) of CERCLA, 42 U.S.C. § 9622(j), on June 27, 1990, U.S. EPA notified the Federal natural resource trustee of negotiations with PRPs on the subject of addressing the release or threatened release of hazardous substances at the Facility;

Certain persons have provided comments on U.S. EPA's proposed plan for remedial action, and to such comments U.S. EPA provided a summary of responses, all of which have been included in the administrative record referred to above;

[Considering] Based on the proposed plan for remedial action and the public comments received, U.S. EPA has reached a decision on a final remedial action plan, which is embodied in a document called a Record of Decision ("ROD") signed by the Regional Administrator on March 30, 1990, [(attached as Appendix 1 hereto),] to which the State has given its concurrence, [and] which includes a discussion of U.S. EPA's reasons for the final plan and for any significant changes from the proposed remedial action plan contained in the FS;

U.S. EPA, pursuant to Section 117(b) of CERCLA, 42 U.S.C. § 6917(b), has provided public notice of adoption of the final remedial action plan set forth in the ROD, including

notice of the ROD's availability to the public for review in the same locations as the administrative record referred to above;

Pursuant to Section 117(d) of CERCLA, 42 U.S.C. § 9617(d), the notice has been published in a major local newspaper of general circulation, and the notice includes an explanation of any significant changes from the proposed remedial action plan contained in the FS and the reasons for such changes;

Pursuant to Section 121(d)(1) of CERCLA, 42 U.S.C. § 9621(d)(1), U.S. EPA [,] and the State [, and Settling Defendants ("the Parties")] believe that the remedial action plan adopted by U.S. EPA will attain a degree of cleanup of hazardous substances, pollutants and contaminants released into the environment and of control of further release which at a minimum assures protection of human health and the environment at the Facility;

[The Parties] U.S. EPA and the State believe the remedial action plan adopted by U.S. EPA, in consultation with the State, will provide a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attains legally applicable or relevant and appropriate standards, requirements, criteria, or limitations under Federal environmental law or State environmental or facility siting law in accordance with Section 121(d)(2) of CERCLA, 42 U.S.C.

§ 9621(d)(2), and that the remedial action plan is in accordance with Section 121 of CERCLA, 42 U.S.C. § 9621, and with the National Contingency Plan ("NCP"), 40 CFR Part 300;

Settling Defendants agree to implement various tasks proposed in the [final] remedial action plan adopted by U.S. EPA [in the ROD as set forth in Appendix 1 to this Consent Decree and incorporated by reference into this Decree, and U.S. EPA has] and the State in the ROD and other tasks necessary to design and implement a remedial action plan as specified in the Scope of Work attached to this Decree. U.S. EPA and the State have determined that the work required under the Consent Decree will be done properly by Settling Defendants and that Settling Defendants are qualified to implement the tasks required in the remedial action plan contained in the ROD; and

The Parties recognize, and intend to further hereby, the public interest in the expedition of the cleanup of the Facility and in avoiding prolonged and complicated litigation between the Parties;

NOW, THEREFORE, it is hereby Ordered, Adjudged and Decreed:

I. PURPOSE OF DECREE

1. The purpose of this Consent Decree is to provide for implementation by Settling Defendants of [the final remedial design and remedial action for the Facility selected

by U.S. EPA, in consultation with the State, as set forth in the Record of Decision] various tasks necessary to design and implement a remedial action plan as set forth in the Scope of Work attached as Appendix 1[, and to provide for payment of certain response costs incurred and to be incurred by the United States and the State for the Facility].

2. The parties do not intend for this Consent Decree to be nor shall it be construed as a totally comprehensive and final response to conditions at the site, rather the work to be performed by Settling Defendants pursuant to this Consent Decree is intended by the parties to be necessary partial corrective action which is consistent with the objectives of the Record of Decision for this site.

II. JURISDICTION

[2.] 3. This Court has jurisdiction over the subject matter herein pursuant to 28 U.S.C. §§ 1331(a) and 1345, and 42 U.S.C. §§ 9613(b) and 9622(d)(1)(A), and over the parties consenting hereto.[Settling Defendants hereby waive service of the summons and complaint in this action.] Settling Defendants shall not challenge this Court's jurisdiction to enter and enforce this Consent Decree.

III. PARTIES BOUND

[3] 4. This Consent Decree applies to and is binding upon the undersigned parties and their agents,

successors and assigns. The undersigned representative of each party to this Consent Decree certifies that he or she is fully authorized by the party or parties whom she or he represents to enter into the terms and conditions of the Consent Decree and to execute and legally bind that party to it. Settling Defendants shall provide a copy of this Consent Decree to the contractor(s) hired to perform the work required by this Consent Decree and shall require the contractor(s) to provide written notice of the decree to any subcontractor retained to perform any part of the work.

IV. DEFINITIONS

[4.] 5. Whenever the following terms are used in this Consent Decree and the [Appendices] Appendix attached hereto, the following definitions shall apply:

"Cleanup Standards" means the requirements respecting the degree of cleanup of groundwater, surface water, soil, air or other environmental media that must be achieved by the remedial action [, as set forth in the ROD, para. 12 of this Decree, and pp. two and three of the SOW] as required by CERCLA.

"Consent Decree" means this Decree and all appendices hereto.

[In the event of conflict between this Decree and any appendix, the Decree shall control.] "Contractor" means the company or companies retained by or on behalf of Settling

Defendants to undertake and complete the work required by this Consent Decree. Each contractor and subcontractor shall be qualified to do those portions of the work for which it is retained.

[Each contractor and subcontractor shall be deemed to be related by contract to each Settling Defendant within the meaning of 42 U.S.C. § 9607(b).] "Expanded Taracorp Pile" means the existing Taracorp Pile as expanded by [its consolidation with the St. Louis Lead Recyclers Piles and residential soils and battery case material added to the Taracorp Pile] the addition of materials pursuant to this response action.

"Facility" refers to the [location where treatment, storage, disposal or other placement of hazardous substances was derived from operations conducted by NL Industries, Inc. (formerly National Lead) and/or Taracorp, Inc., whose operations are] property currently owned by Taracorp, Inc., Trust 454 and Tri-City Trucking located in Granite City, Madison County, State of Illinois, [including, but not limited to, areas 1-8 and designated areas of Eagle Park Acres and Venice, as shown more particularly on the maps attached to the Record of Decision as Figures 5, 6, 7] as illustrated in Figure 1 attached to this Decree.

"Hazardous substance" shall have the meaning provided in Section 101(14) of CERCLA, 42 U.S.C. § 9601(14).

"IEPA" means the Illinois Environmental Protection Agency.

"National Contingency Plan" or "NCP" means the term used in Section 105 of CERCLA, 42 U.S.C. § 9605 and is promulgated at 40 CFR Part 300.

"Off-Site Impacted Areas" means residential, commercial and industrial areas where treatment, storage, disposal or other placement of hazardous substances occurred through the operation of the facility.

"Oversight Costs" means any costs not inconsistent with the National Contingency Plan incurred by U.S. EPA [and the State of Illinois in monitoring] in overseeing the compliance of the Settling Defendants with this Consent Decree, including but not limited to payroll and other direct costs, [indirect and overhead costs, sampling and laboratory costs, travel, contractor costs and costs of review of the work performed pursuant to this Consent Decree].

"Owner Settling Defendants" refers to [NL Industries,] Taracorp, Inc., [and] Trust 454, and Tri-City Trucking.

"Parties" means the United States of America, the State of Illinois and the Settling Defendants.

"RD/RA Work Plan" means the plan for the design of the remedial action for the Facility[, as described in para. 13(a)].

"Record of Decision" or "ROD" means the administrative Record of Decision issued by U.S. EPA [setting forth the

remedial action requirements for the Facility, attached as Appendix 1 hereto].

"Remedial Project Manager" or "RPM" means the person designated by U.S. EPA to coordinate, monitor or direct remedial activities at the Facility pursuant to 40 [CFR] C.F.R. § 300.33 and Section XII hereof.

"Residential Areas" means residential housing and any area where children are routinely exposed to soils, such as schools, parks, playgrounds, and day care facilities[, and religious institution].

"Response Costs" means any costs not inconsistent with the National Contingency Plan incurred by the United States [and the State of Illinois] pursuant to 42 U.S.C. §§ 9601 et seq.

"Scope of Work" or "SOW" means the plan, set forth as Appendix [2] 1 to this Decree, for implementation of the [remedial design and remedial action at the Facility pursuant to the Record of Decision] work as that term is defined in this Consent Decree, and any subsequent amendments of Appendix [2] 1 pursuant to the provisions of this Decree.

"Settling Defendants" means those parties other than the United States of America or the State of Illinois who sign this Consent Decree.

"State" means the State of Illinois.

"St. Louis Lead Recyclers Piles" or "SLLR Piles" means the waste piles which were created by or a part of the operations of St. Louis Lead Recyclers, Inc.

"Taracorp Pile" means the waste pile on or near the Site but not the SLLR Piles.

"United States" means the United States of America.

"U.S. DOJ" means the United States Department of Justice.

"U.S. EPA" means the United States Environmental Protection Agency.

"Work" means the design, construction and implementation, in accordance with this Consent Decree, of the tasks described in [the ROD,] this Decree, the Scope of Work, the Work Plan(s), and any other plans or schedules submitted and approved by U.S. EPA pursuant to this Decree or the SOW. The following are the major components of the [Remedial Action:] Work:

[a. Installation of an upgraded security fence around the Expanded Taracorp Pile.]

a. A demographic study of the population of Granite City.

[b. Deed Restrictions and other institutional controls to ensure protection of the Taracorp Pile.]

b. A blood lead study of the population of Granite City.

[c. Performance of soil lead sampling to determine which areas must be excavated and the extent of the excavation.]

c. Home inspections to identify possible sources of lead exposure.

[d. Inspection of alleys and driveways and areas containing surficial battery case material in Venice, Eagle Park Acres, Granite City, Madison and any other nearby communities to determine whether additional areas not identified in the Feasibility Study must be remediated.]

d. Investigation of the distribution of lead-bearing soils in Granite City.

[e. Performance of blood lead sampling to provide the community with current data on potential acute health effects associated with site contamination.]

e. As an extension of tasks, a-d above, development of a plan for a risk assessment for the site that is acceptable to U.S. EPA, and implementation of the plan, if deemed appropriate by U.S. EPA.

[f. Installation of a minimum of one upgradient and three downgradient deep wells, monitoring of groundwater and air, and inspection and maintenance of the cap.]

f. Development of a system for monitoring the ground water.

[g. Removal and recovery of all drums on the Taracorp Pile at a secondary lead smelter.]

g. Inspection of driveways and alleys in selected neighborhoods for battery casing materials.

[h. Consolidation of waste contained in an adjacent St. Louis Lead Recyclers Piles with the Taracorp Pile.]

h. Recycling, if possible, of the drums from the Taracorp pile.

i. [Excavation and consolidation with the Taracorp Pile or off-site disposal of battery case material from all applicable alleys and driveways in Venice, Illinois, Eagle Park Acres, and any other nearby communities.] Consolidation of the SLLR waste pile with the Taracorp pile.

[j. Excavation and consolidation with the Taracorp Pile of all unpaved portions of adjacent Area 1 with lead concentrations greater than 1000 ppm.]

j. A treatability study of the battery casing material.

[k. Excavation and consolidation with Taracorp Pile or off-site disposal of all residential soils and battery case materials around the site and in Venice, Eagle Park Acres, and any other nearby communities with lead concentrations greater than 500 ppm.]

k. Design of a cap for the expanded Taracorp pile.

[l. Inspection of the interiors of homes on property to be excavated to identify possible additional sources of lead

exposure and recommend appropriate actions to minimize exposure.]

1. Development of environmental contingency plans for actions to be taken in the event that future monitoring data indicate that air or ground water is found to be contaminated by releases from the site in the future.

[m. Implementation of dust control measures during all remedial construction activities.

n. Construction of a RCRA-compliant, multi-media cap over the Expanded Taracorp Pile and a clay liner under all newly-created portions of the Expanded Taracorp Pile.

o. Development and implementation of contingency plans to provide remedial action in the event that the concentration of contaminants in groundwater or lead or PM10 (particulate matter greater than 10 microns) in air exceed applicable standards or established action levels, or that waste materials or soils have become releasable to the air in the future.

p. Development and implementation of contingency measures to provide for sampling and removal of any soils within the zone of contamination described by the soil lead sampling to be implemented above with lead concentrations above 500 ppm which are presently capped by asphalt or other barriers but become exposed in the future due to land use changes or deterioration of the existing use]

- m. Development of a dust control plan for use during all remedial construction activities to mitigate the release of contaminated soils.

V. GENERAL PROVISIONS

- [5.] 6. Commitment of Settling Defendants to Perform [RD/RA] Activities Required by this Consent Decree.

a. Settling Defendants agree jointly and severally to finance and perform the Work as defined in paragraph [4] 5 hereof.

b. The Work shall be completed in accordance with all requirements of this Decree, [the ROD,] the SOW, the [RD/RA] Work Plan and all other plans or schedules submitted and approved by U.S. EPA under this Decree. The procedures for submission and approval of plans are set forth in Section VI below.

- [6] 7. Compliance with Applicable Laws; Permits and Approvals

a. All activities undertaken by the Settling Defendants pursuant to this Consent Decree shall be undertaken in accordance with the requirements of all applicable federal and state laws, regulations and permits, as required by CERCLA.

b. Pursuant to Section 121(e)(1) of CERCLA, no federal, state, or local permits are required for work conducted entirely on the Facility. Settling Defendants shall

obtain all permits or approvals necessary for work off the Facility under applicable federal, state or local laws with the assistance of U.S. EPA, if requested, and shall submit timely applications and requests for any such permits and approvals.

c. The standards and provisions of Section XIII hereof describing Force Majeure shall govern delays in obtaining permits required for the Work and also the denial of any such permits, provided that Settling Defendants have made timely and complete application for any such permits.

d. Settling Defendants shall include in all contracts or subcontracts entered into for work required under this Consent Decree, provisions stating that such contractors or subcontractors, including their agents and employees, shall perform all activities required by such contracts or subcontracts in compliance with all applicable laws and regulations.

e. This Consent Decree is not a permit issued pursuant to any federal or state statute or regulation.

[7] 8. Formal Approval Required. No informal advice, guidance, suggestions or comments by representatives of the United States or the State on plans, reports or other documents submitted by the Settling Defendants shall be construed as relieving them from obtaining any formal approvals, permits or other authorizations required by law or by this Decree. Further, no advice, guidance, suggestions or

comments by such government representatives with respect to any submission by the Settling Defendants shall be construed so as to relieve them of their obligations under this Decree or to transfer any of their liability or obligations under this Decree to any other party or person.

[8] 9. Computation of Time. Unless otherwise provided, dates and time periods specified in or under this Decree are in calendar days. If the date for submission of and item or notification required by this Decree falls upon a weekend or state or federal holiday, the time period for submission of that item or notification is extended to the next working day following the weekend or holiday. Submission shall be deemed accomplished when the item is delivered or mailed to the required party or parties.

[9] 10. Conveyance of the Facility and Institutional Controls

a. Copy of Decree to be Recorded. Within thirty days of approval by the Court of this Decree, [Taracorp and Trust 454,] the ["] Owner Settling Defendants, ["] Taracorp, Trust 454 and Tri-City Trucking, shall record a copy of this Decree with the Recorder's Office, Madison County, State of Illinois, in the chain of title for each parcel of Facility property owned by the Owner Settling Defendants.

b. Alienation of Facility. The Facility may be freely alienated provided that at least sixty days prior to the date of such alienation, the Owner Settling Defendant notifies

the United States and the State of such proposed alienation, the name of the grantee, and a description of the Owner Settling Defendants' obligations, if any, to be performed by such grantee. In the event of such alienation, [all of Settling Defendants'] the obligations pursuant to this Decree of the Settling Defendants', and the Owner Settling Defendants shall continue to be met by [all] said Owner Settling Defendants, Settling Defendants and the grantee.

c. Notice. Any deed, title or other instrument of conveyance regarding the Facility shall contain a notice that the Facility is the subject of this Consent Decree, setting forth the style of the case, case number, and Court having jurisdiction herein.

d. Institutional Controls. The U.S. EPA and IEPA have determined that institutional controls are necessary to effectuate the remedial action for the facility and to protect the public health or welfare or the environment.

[1.] A. Until such time that U.S. EPA notifies Owner Settling Defendants in writing that it is no longer necessary to protect human health and the environment, Owner Settling Defendants shall construct and maintain in good repair a security fence around the perimeter of the Expanded Taracorp Pile and shall prominently display warning signs.

[2] B. The Owner Settling Defendants shall submit to U.S. EPA and the local zoning authority or the authority with jurisdiction over local land use a survey plat. This

survey plat shall be submitted within 60 calendar days after completion of the expanded Taracorp pile. The survey plat must be prepared by a professional land surveyor. The survey plat must indicate, at a minimum, permanent benchmarks, all deed and use restrictions on the property and the location and dimension of the expanded Taracorp pile.

[3.] C. Sixty (60) calendar days after completion of the expanded Taracorp pile, and until such time as U.S. EPA determines that these restrictions are no longer necessary to protect human health and the environment, the Owner Settling Defendants shall restrict use and access to the Expanded Taracorp Pile, except for U.S. EPA, IEPA and Settling Defendants and/or either of their authorized representatives, as needed for purposes of conducting maintenance, inspection or evaluations of the Facility and any other actions necessary for this Order, in such a manner that:

- i. there shall be no use or occupancy of the facility except for the purpose of implementing the remedial actions required by this Administrative Order. Prohibited uses include, but are not limited to, both commercial and recreational uses.
- ii. there shall be no installation, construction or use of any buildings, wells, pipes, roads, ditches or any other structures at the facility except as

approved by the U.S. EPA as being consistent with this Consent Decree.

[4.] D. Taracorp, Inc. [and], Trust 454 and Tri-City Trucking, as the present owners of the Facility, shall record in accordance with State law a notation on the deed to the Facility property or on some other instrument which is normally examined during title search that will notify any potential purchaser of the property of the existence of this Order and the restrictions in 3 above. Taracorp, Inc. [and], Trust 454 and Tri-City Trucking shall also submit signed certifications that they have recorded the notation specified in this paragraph and a copy of the document in which the notation has been placed to the Remedial Project Manager (RPM) for U.S. EPA and the Project Manager (PM) for IEPA. The Owner Settling Defendants shall record the notation and submit a copy of it to the RPM and P" within sixty (60) calendar days after completion of the Expanded Taracorp Pile.

[5.] E. Sixty (60) calendar days before the start of any remedial construction activity, Settling Defendants shall obtain, and submit to U.S. EPA and IEPA, any additional easements, or other enforceable instruments allowing Settling Defendants use of any other property which is necessary for the implementation of [the] any remedial action required by this Consent Decree.

F. This Section V of the Decree requires execution by one or more Owner Settling Defendants to be enforceable.

VI. PERFORMANCE OF THE WORK
BY SETTLING DEFENDANTS

[10] 11. Selection of Architect/Engineer and Contractor(s).

a. [Engineer. All remedial design] Contractor.
All work to be performed by the Settling Defendants pursuant to this Consent Decree shall be under the direction and supervision of a qualified professional engineer selected in accordance with the Protocol agreed to by the parties contained in the SOW [engineer. Selection of any such engineer is subject to approval by U.S. EPA in consultation with the State.

b. Contractor. All remedial action work to be performed by the Settling Defendants pursuant to this Consent Decree shall be under the direction and supervision of a qualified professional engineer]. As soon as possible after entry of the Decree, and at least 30 days prior to the date upon which initiation of [remedial action] the work [is] required under this Decree, the Settling Defendants shall notify U.S. EPA and the State, in writing, of the name, title, and qualifications of the proposed engineer, and the names of principal contractors and subcontractors proposed to be used in carrying out the Work to be performed pursuant to this Consent Decree. Selection of any such engineer or contractor and/or subcontractor shall be

subject to approval by the U.S. EPA in consultation with the State.

c. Disapproval of Engineer or Contractor. If U.S. EPA disapproves of the initial or subsequent selection of an engineer or contractor, U.S. EPA shall notify Settling Defendants within fourteen (14) days and provide the reasons for such disapproval. Such approval shall not be unreasonably withheld. Settling Defendants shall submit a list of alternate engineers or contractors to U.S. EPA and the State within 30 days of receipt of the notice of disapproval. Within 14 days from receipt of the list U.S. EPA, in consultation with the State, shall provide written notice of the names of the engineers or contractors on the list of which it approves. Settling Defendants may select any approved architect, engineer or contractor from the list and shall notify U.S. EPA and the State of the name of the person or entity selected within 21 days of receipt of the list. If U.S. EPA does not approve or disapprove of any proposed architect, engineer, or contractor or any proposed list of alternate architects, engineers, or contractors within 14 days and the delay prevents Settling Defendants from meeting one or more deadlines in a plan approved by U.S. EPA pursuant to this decree, Settling Defendants may seek relief under the provisions of Section XIII hereof.

d. Replacement of Architect/Engineer or Contractor. If at any time Settling Defendants propose to

change an architect, engineer or contractor previously approved by U.S. EPA, they shall give written notice to U.S. EPA and the State of the name, title and qualifications of the proposed new architect, engineer or contractor. Such architect, engineer or contractor shall not perform any Work until approval by U.S. EPA, in consultation with the State, has been given. Such approval shall not be unreasonably withheld.

12. [11.] Scope of Work. Appendix [2] 1 to this Consent Decree provides a Scope of Work ("SOW") for the completion of remedial design and remedial action at the Facility. This Scope of Work is incorporated into and made an enforceable part of this Consent Decree.

[12. Cleanup and Performance Standards. The Work performed under this Consent Decree shall meet the Performance Standards set forth in Section II of the Scope of Work, which shall include, but are not limited to:

- a. removal of all drums at the Taracorp Pile;
- b. excavation of battery case material at or near the surface of all alleys and driveways in Venice, Eagle Park Acres, and other nearby communities (including areas in ROD Figures 6, 7);
- c. construction of a RCRA complaint cap over the Expanded Taracorp Pile;
- d. implementation of air and groundwater monitoring and remediation, if necessary, as specified in the contingency plans, as approved by U.S. EPA.

The Cleanup Standards described in Section II of the SOW include, but are not limited to:

a. an Area 1 cleanup standard of 1000/ppm soil lead;

b. a 500 ppm soil lead and battery case material cleanup standard for all Residential Areas containing concentrations of lead greater than 500 ppm, based on sampling during the remedial design.]

13. Work Plan.

a. Within [60] 120 days of the [lodging] entry of this Consent Decree, the Settling Defendants shall commence [remedial design work] the activities required by this Consent Decree by submitting the [RD/RA] Work Plan to U.S. EPA and the state. [State. RD/RA Work Plan submittals shall include the plans listed in Task I of Section III of the Scope of Work. Settling Defendants shall not be required to pay any Oversight Costs for U.S. EPA's or the State's review of their work prior to entry of the decree under this paragraph, but following entry shall pay all such Oversight Costs that accrued prior to entry pursuant to Section XVI hereof.]

b. [Within 60 days of the entry of this Consent Decree, the Settling Defendants shall submit the remaining plans needed to complete the Work. The submittals shall include each of the requirements of Section III, Task II of the Scope of Work.

c.] All plans submitted shall be developed in conformance with the ROD, the SOW, U.S. EPA Superfund Remedial Design and Remedial Action Guidance and any additional guidance documents provided by U.S. EPA that are in effect at the time of plan submission. If an applicable U.S. EPA guidance document is changed or is issued which requires modification of plans under development, U.S. EPA may adjust deadlines of such plans as U.S. EPA deems necessary to incorporate such guidance into the plan being developed.

[d] c. All plans shall be subject to review, modification and approval by U.S. EPA, in consultation with the State, in accordance with the procedures set forth in para. 14 below.

[e] d. All approved plans shall be deemed incorporated into and made an enforceable part of this Consent Decree. All work shall be conducted in accordance with the National Contingency Plan, the U.S. EPA Superfund Remedial Design and Remedial Action Guidance, and the requirements of this Consent Decree, including the standards, specifications and schedule contained in the Work Plan.

14. Approval Procedures for Work Plans and Other Documents.

a. Upon review of each work plan or other document required to be submitted and approved by U.S. EPA pursuant to this Decree, and after consultation with the State,

the U.S. EPA Remedial Project Manager (the "RPM") shall notify Settling Defendants, in writing, that a document is (1) approved, (2) disapproved, or (3) [modified by U.S. EPA to cure deficiencies, or (4)] returned to Settling Defendants for modification. [An] Such notification must be given within thirty (30) days of receipt of the Work Plan or other documents from Settling Defendants. A written explanation shall be provided for any disapproval or required modification.

b. Approved plans will not be subject to change or modification by EPA absent a showing of a danger to human health and the environment.

c. Upon approval or modification of a submission by U.S. EPA, Settling Defendants shall proceed to implement the work required.

[c] d. In the event of partial U.S. EPA disapproval or request for modification by Settling Defendants, the Settling Defendants shall proceed to implement the work in any approved portions of the submission upon request by U.S. EPA, and shall submit a revised document to U.S. EPA and the State curing the deficiencies within 30 calendar days of receipt of notice from U.S. EPA or such other time as may be agreed to by the parties.

[d] e. Settling Defendants may submit any disapproval, modification, or conditions of approval to which they object, for dispute resolution pursuant to Section XIV

hereof. The provisions of Section XIV (Dispute Resolution) and Section XVII (Stipulated Penalties) shall govern the implementation of Work and accrual and payment of any stipulated penalties during dispute resolution. Implementation of non-deficient portions of the submission shall not relieve Settling Defendants of any liability for stipulated penalties under Section XVII.

VII. ADDITIONAL WORK AND MODIFICATION OF THE SOW

15. No Warranty. The provisions of the SOW attached as Appendix [2] 1 reflect the parties' best efforts at the time of execution of this Decree to define the technical work required to perform the remedial action described in the ROD. The Parties acknowledge and agree that approval by U.S. EPA of [neither] either the SOW [nor] or the Work Plan [constitutes] does not constitute a warranty or representation of any kind that the SOW or Work Plan will achieve the Cleanup and Performance Standards, and shall not foreclose the United States or the State from seeking compliance with the applicable Cleanup and Performance Standards.

16. Modification of the Scope of Work. The parties recognize that modification of the SOW may be required at some point in the future, e.g. to provide for additional work needed to meet the Clean-up and Performance Standards specified above or for the deletion of work which is not necessary to achieve

those standards. In such event, the following procedures shall be followed to amend the SOW:

- a. The party that determines that additional work or other modification of the SOW is necessary shall provide written notice of such determination to the other parties.
- b. The other parties shall respond to such notice in writing within thirty (30) days of receipt or such other time as may be agreed to by the parties.

17. Modification by Agreement. If the parties agree on the modifications to the SOW, the agreement shall be in writing and shall be submitted, along with the amended SOW, for approval of the Court.

18. Dispute Resolution. If the parties do not agree on the proposed modifications, they shall initiate dispute resolution pursuant to Section XIV of this Decree. The scope and standard of review set forth in para. [40] 39.e. shall govern any judicial determination in such dispute.

VIII. DETERMINATION OF THE REMEDIAL ACTION.

[U.S. EPA PERIODIC REVIEW TO
ASSURE PROTECTION OF HUMAN
HEALTH AND THE ENVIRONMENT]

19. [To the extent required by Section 121(c) of CERCLA, 42 U.S.C. § 9621(c), and any applicable regulations, U.S. EPA, in consultation with the State, shall review the

remedial action at the Facility at least every five (5) years after the entry of this Consent Decree to assure that human health and the environment are being protected by the remedial action being implemented. If upon such review, U.S. EPA determines that further response action is appropriate at the Facility in accordance with Section 104 or 106, then, consistent with Section XVIII of this Consent Decree, the U.S. EPA, in consultation with the State, may take or require such action.] Upon termination and satisfaction of this Decree in accordance with Paragraph 74:

[20.] a. The U.S. EPA shall notify the Settling Defendants and any known responsible parties identified by the U.S. EPA to proceed with the Remedial Design/Remedial Action ("RD/RA").

b. Sixty (60) days after the Settling Defendant's receipt of notification pursuant to Paragraph 19.a. above, the Settling Defendants, and any other PRPs identified by U.S. EPA, shall notify the U.S. EPA whether or not they will perform the entire RD/RA. Regardless of its participation in the performance of the RD/RA, the Settling Defendants [shall be provided with an opportunity to confer with U.S. EPA and the State on any response action proposed as a result of U.S. EPA's 5-year review and to submit written comments for the record. The final decision of U.S. EPA shall be subject to judicial review pursuant to the dispute resolution provisions in Section

XIV hereof, if U.S. EPA seeks to require] will undertake to perform the tasks identified in Paragraph 19.d. If Settling Defendants agree to complete the entire RD/RA, the parties shall negotiate a supplemental agreement to be signed and lodged under this Consent Decree.

c. If Settling Defendants decline to perform the selected remedy, the U.S. EPA may, in accordance with the applicable law, perform and pay for the selected remedy. U.S. EPA reserves its right to file claims against the Settling Defendants [to undertake such work.] in a proceeding to recover response costs, not inconsistent with the National Contingency Plan, expended by U.S. EPA in performing the RD/RA. Settling Defendants reserve any rights they may have with respect to liability for U.S. EPA's costs for work performed by the Agency outside of this Consent Decree. The Settling Defendants do not waive any rights they may have pursuant to CERCLA, as amended, to contest any U.S. EPA decisions to perform any further remediation, and any and all rights and defenses it may have. This reservation of rights shall not apply to tasks identified in Paragraph 19.d.

d. (1) Notwithstanding the above, the Settling Defendants agree to pay for the development of an RD/RA Work Plan.

(ii) The RD/RA Work Plan submittal shall include a schedule for submittal of the following project

plans: (1) a sampling and analysis plan; (2) a health and safety/contingency plan; (3) a plan for satisfaction of permitting requirements; (4) a quality assurance project plan; (5) a groundwater monitoring plan; and (6) an operations and maintenance plan. The RD/RA work plan shall also include a schedule for implementation of the RD/RA tasks and submittal of RD/RA reports.

IX. QUALITY ASSURANCE

[21.] 20. Settling Defendants shall use quality assurance, quality control, and chain of custody procedures in accordance with U.S. EPA's "Interim Guidelines and Specifications For Preparing Quality Assurance Project Plans" (QAM-005/80) and subsequent amendments to such guidelines upon notification to Settling Defendants of such amendments by U.S. EPA. Amended guidelines shall apply only to procedures conducted after such notification. Prior to the commencement of any monitoring project under this Consent Decree, Settling Defendants shall submit Quality Assurance Project Plan(s) ("QAPP") to U.S. EPA and the State, consistent with the SOW and applicable guidelines, in accordance with paras. 13-14 hereof. Validated sampling data generated consistent with the QAPP(s) and reviewed and approved by EPA shall be admissible as evidence, without objection, in any proceeding to enforce this Decree. Each laboratory utilized by Settling Defendants in implementing this Consent Decree shall be subject to approval

by U.S. EPA and the State. Such approval shall not be unreasonably withheld. Settling Defendants shall assure that U.S. EPA and State personnel or authorized representatives are allowed access to each such laboratory. In addition, Settling Defendants shall have their laboratory analyze samples submitted by U.S. EPA or the State for quality assurance monitoring.

X. FACILITY ACCESS, SAMPLING, DOCUMENT AVAILABILITY

[22] 21. Access to Facility and Other Property Controlled by Settling Defendants. As of the date of lodging of this Consent Decree, the United States and the State, and Settling Defendants' contractors shall have access at all times to the Facility, and shall have access to any other property controlled by or available to Settling Defendants to which access is necessary to effectuate the remedial design or remedial action required pursuant this Decree. Access shall be allowed for the purposes of conducting activities related to this Decree, including but not limited to:

- a. Monitoring the Work or any other activities taking place at the Facility;
- b. Verifying any data or information submitted to the United States or the State;
- c. Conducting investigations relating to contamination at or near the Facility;
- d. Obtaining samples;

e. Assessing the need for, planning, or implementing additional response actions at or near the Facility;

f. Inspecting and copying records, operating logs, contracts or other documents maintained or generated by Settling Defendants or their agents, consistent with this Decree and applicable law; or

g. Assessing Settling Defendants' compliance with this Consent Decree.

h. This Section X of the Decree requires acceptance and execution by Owner Settling Defendants to be enforceable.

22. [23.] Access to Other Property. To the extent that the Facility or other areas where Work is to be performed hereunder is presently owned by persons other than Settling Defendants, Settling Defendants shall use best efforts to secure from such persons access for Settling Defendants' contractors, the United States, the State, and their authorized representatives, as necessary to effectuate this Consent Decree. If necessary access is not obtained despite best efforts [within 30 calendar days of the date of entry of this Decree], Settling Defendants shall promptly notify the United States. The United States thereafter [may] will assist Settling Defendants in obtaining access, to the extent necessary to effectuate the remedial action for the Facility,

using such means as it deems appropriate. The United States' costs in this effort, including attorney's fees and other expenses [and any compensation that the United States may be required to pay to the property owner,], shall be considered costs of response [and shall be reimbursed by]. Neither the United States nor Settling Defendants [in accordance with Section XVI of this Decree (Reimbursement).] shall be required to compensate the property owner for such access.

[24] 23. Access Authority Retained. Nothing herein shall restrict in any way the United States' access authorities and rights under CERCLA, RCRA or any other applicable statute, regulation or permit.

[25.] 24. Sampling Availability. Settling Defendants shall make available to U.S. EPA and the State, upon request, the results of all sampling and/or tests or other data generated by Settling Defendants with respect to the implementation of this Consent Decree. U.S. EPA and the State, upon request, shall make available to the Settling Defendants the results of sampling and/or tests or other data generated by U.S. EPA, the State, or their contractors.

[26] 25. Split Samples. Upon request, a party taking samples shall allow other parties and/or their authorized representatives to take split or duplicate samples. The party taking samples shall give at least 14 days prior notice of sample collection activity to the other parties.

XI. REPORTING REQUIREMENTS

[27.] 26. Monthly Progress Reports. Settling Defendants or their contractors, engineers or other representatives shall prepare and provide to the United States and the State written monthly progress reports which: (1) describe the actions which have been taken toward achieving compliance with this Consent Decree during the previous month, and attach copies of appropriate supporting documentation [such as invoices, contract documents and photographs]; (2) include all results of sampling and tests and all other data received by Settling Defendants during the course of the work which has passed quality assurance and quality control procedures; (3) include all plans and procedures [completed] prepared under the [RD/RA] Scope of Work [Plan] during the previous month; (4) describe all actions, data and plans which are scheduled for the next month and provide other information relating to the progress of [construction] the Work; (5) include information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule for implementation of [RD/RA] the Scope of Work [or] the Work Plan, and a description of efforts made to mitigate those delays or anticipated delays. Progress reports are to be submitted to U.S. EPA and the State by the tenth day of every month following the effective date of this Consent Decree.

[28] 27. Other Reporting Requirements. Settling Defendants shall submit reports, plans and data required by the

SOW, the RD/RA Work Plan or other approved plans in accordance with the schedules set forth in such plans.

[29] 28. Reports of Releases. Upon the occurrence of any event during performance of the Work which, pursuant to Section 103 of CERCLA, requires reporting to the National Response Center, Settling Defendants shall promptly orally notify the U.S. EPA Remedial Project Manager ("RPM") or On-Scene Coordinator ("OSC"), or in the event of the unavailability of the U.S. EPA RPM, the Emergency Response Section, Region V, United States Environmental Protection Agency, in addition to the reporting required by Section 103. Within 20 days of the onset of such an event, Settling Defendants shall furnish to the United States and the State a written report setting forth the events which occurred and the measures taken, and to be taken, in response thereto. Within 30 days of the conclusion of such an event, Settling Defendants shall submit a report setting forth all actions taken to respond thereto.

[30] 29. Annual Report. Settling Defendants shall submit each year, within thirty (30) days of the anniversary of the entry of the Consent Decree, a report to the Court and the parties setting forth the status of response actions at the Facility, which shall include at a minimum a statement of major milestones accomplished in the preceding year, a statement of tasks remaining to be accomplished, and the schedule for implementation of the remaining Work.

XII. REMEDIAL PROJECT MANAGER/PROJECT COORDINATORS

[31] 30. Designation/Powers. U.S. EPA shall designate a Remedial Project Manager ("RPM") and/or an On Scene Coordinator ("OSC") and the IEPA shall designate a Project Manager (PM) for the Facility, and they may designate other representatives, including U.S. EPA and State employees, and federal and state contractors and consultants, to observe and monitor the progress of any activity undertaken pursuant to this Consent Decree. The RPM/OSC shall have the authority lawfully vested in an RPM/OSC by the National Contingency Plan, 40 [CFR] C.F.R. Part 300. In addition, the RPM/OSC shall have the authority to halt any work required by this Consent Decree and to take any necessary response action when conditions at the Facility may present an imminent and substantial endangerment to public health or welfare or the environment. Such action by the RPM/OSC shall constitute a force majeure in accordance with Section XIII. Settling Defendants shall also designate a Project Coordinator who shall have primary responsibility for implementation of the Work at the Facility.

[32] 31. Communications. To the maximum extent possible, except as specifically provided in the Consent Decree, communications between Settling Defendants, the State and U.S. EPA concerning the implementation of the work under this Consent Decree shall be made between the Project Coordinators and the RPM/OSC.

[33] 32. Identification of Personnel. Within twenty (20) calendar days of the effective date of this Consent Decree, Settling Defendants, IEPA, and U.S. EPA shall notify each other, in writing, of the name, address and telephone number of the designated Project Manager and an Alternate Project Manager, and the RPM/OSC and Alternate RPM/OSC. If the identity of any these persons changes, notice shall be given to the other parties at least five (5) business days before the changes become effective.

XIII. FORCE MAJEURE

[34.] 33. Definition. "Force Majeure" for purposes of this Consent Decree is defined as any event arising from causes beyond the control of Settling Defendants which delays or prevents the performance of any obligation under this Consent Decree notwithstanding Settling Defendants' best efforts to avoid the delay. Increased costs or expenses [or non-attainment of the Performance or Clean-Up Standards]shall not constitute "force majeure" events.

[35.] 34. Notice to RPM Required. When circumstances occur which may delay the completion of any phase of the Work or delay access to the Facility or to any property on which any part of the Work is to be performed, whether or not caused by a "force majeure" event, Settling Defendants shall upon becoming aware of such circumstances, promptly notify the RPM and the State Project Coordinator by telephone, or in the event of

their unavailability, the Director of the Waste Management Division of U.S. EPA. Within twenty (20) days of the event which Settling Defendants contend is responsible for the delay, Settling Defendants shall supply to the United States and the State in writing the reason(s) for and anticipated duration of such delay, the measures taken and to be taken by Settling Defendants to prevent or minimize the delay, and the timetable for implementation of such measures. Failure to give such oral notice and written explanation in a timely manner shall constitute a waiver of any claim of force majeure.

[36.] 35. If U.S. EPA agrees that a delay is or was attributable to a "force majeure" event, the Parties shall modify the SOW or [RD/RA] Work Plan to provide such additional time as may be necessary to allow the completion of the specific phase of Work and/or any succeeding phase of the Work affected by such delay.

[37.] 36. If U.S. EPA does not agree with Settling Defendants that the reason for the delay was a "force majeure" event, that the duration of the delay is or was warranted under the circumstances, or that the length of additional time requested by Settling Defendants for completion of the delayed work is necessary, U.S. EPA shall so notify Settling Defendants in writing. Settling Defendants shall initiate a formal dispute resolution proceeding under para. 39 below no later than 15 days after receipt of such notice. In such a

proceeding, Settling Defendants have the burden of proving, by a preponderance of the evidence, that the event was a force majeure, that best efforts were exercised to avoid and mitigate the effects of the delay, that the duration of the delay is or was warranted, that the additional time requested for completion of the Work involved is necessary to compensate for the delay, and that the notice provisions of para. 35 were complied with.

XIV. DISPUTE RESOLUTION

[38] 37. The Parties to this Consent Decree shall attempt to resolve expeditiously any disagreements concerning the meaning, application or implementation of this Consent Decree. Any party seeking dispute resolution first shall provide the other parties with an "Informal Notice of Dispute" in writing and request an informal dispute resolution period, which shall not exceed thirty (30) days.

[39] 38. If the dispute is not resolved within the informal discussion period, any party may initiate formal dispute resolution by giving a written "Formal Notice of Dispute" to the other parties no later than the 15th day following the conclusion of the informal dispute resolution period. A party shall seek formal dispute resolution prior to the expiration of the informal discussion period where the circumstances require prompt resolution.

[40.] 39. Formal dispute resolution for disputes [pertaining to the selection or adequacy of remedial design or remedial action (including the selection and adequacy of any plans which are required to be submitted for government approval under this Decree and the adequacy of Work performed)]shall be conducted according to the following procedures:

a. Within [ten (10)] twenty (20) days of the service of the Formal Notice of Dispute pursuant to the preceding paragraph, or such other time as may be agreed to by the parties, the party who gave the notice shall serve on the other parties to this Decree a written statement of the issues in dispute, the relevant facts upon which the dispute is based, and factual data, analysis or opinion supporting its position (hereinafter the "Statement of Position"), and shall provide copies of all supporting documentation on which such party relies. A Statement of Position may incorporate by reference, and thereby include, supporting documents previously submitted to the other party or documents which are readily and easily accessible to the public.

b. Opposing parties shall serve their Statements of Position and copies of supporting documentation within twenty (20) days after receipt of the complaining party's Statement of Position or such other time as may be agreed to by the parties.

c. U.S. EPA shall maintain an administrative record of any dispute governed by this paragraph. The record shall include the Formal Notice of Dispute, the Statements of Position, all supporting documentation submitted by the parties, and any other material on which the U.S. EPA decisionmaker relies for the administrative decision provided for below. The record shall be available for inspection and copying by all parties. The record shall be closed no less than ten (10) days before the administrative decision is made, and U.S. EPA shall give all parties prior notice of the date on which the record will close.

d. Upon review of the administrative record U.S. EPA shall issue a final decision and order resolving the dispute.

e. Any decision and order of U.S. EPA pursuant to subparagraph d. shall be reviewable by this Court, provided that a Notice of Judicial Appeal is filed within 10 days of receipt of U.S. EPA's decision and order. [Judicial review will be conducted on U.S. EPA's administrative record and U.S. EPA's decision shall be upheld unless it is demonstrated to be arbitrary and capricious or in violation of law.] The standard of review for dispute resolution shall be determined by the Court in accordance with the provisions of CERCLA.

[41. Judicial dispute resolution for any issues not governed by the preceding paragraph may be initiated by

petition to the Court and shall be governed by the Federal Rules of Civil Procedure. Except as specifically provided in other provisions of this Decree, e.g. Section XIII, this Decree does not establish procedures or burdens of proof for such dispute resolution proceedings.

42.] 40. The invocation of the procedures stated in this Section shall [not extend or] postpone Settling Defendants' obligations under this Consent Decree with respect to the disputed issue unless [and until U.S. EPA agrees otherwise. EPA's position on an issue in dispute shall control until such time as]the Court orders otherwise [in accordance with the provisions of this Section.]_

[43.] 41. Any applicable Stipulated Penalties will not continue to accrue during [dispute resolution, as provided in Section XVII hereof. Settling Defendants may seek forgiveness of stipulated penalties that accrue during] the dispute resolution [by petition to U.S. EPA and/or the Court pursuant to para. 62. below.] period.

[44.] 42. Upon the conclusion of any formal or informal dispute resolution under this Section which has the effect of nullifying or altering any provision of the [RD/RA] Work Plan or any other plan or document submitted and approved pursuant to this Decree, Settling Defendants shall submit an amended plan, in accordance with the decision, to U.S. EPA within fifteen (15) days of receipt of the final order or

decision. Amendments of the SOW as a result of dispute resolution proceedings are governed by Section VII above. Amendments of a plan or other document as a result of dispute resolution shall not alter any dates for performance unless such dates have been specifically changed by the order or decision. Extension of one or more dates of performance in the order or decision does not extend subsequent dates of performance for related or unrelated items of Work unless the order or decision expressly so provides or the parties so agree.

43. The Court's determination shall bind all signatories to this Consent Decree. Each party shall bear its own attorney's fees on legal costs resulting from utilization of the judicial review provisions of these dispute resolution procedures.

XV. RETENTION AND AVAILABILITY OF INFORMATION

[45.] 44. Settling Defendants shall make available to U.S. EPA and the State and shall retain the following documents [until 6 years following the third "five-year review" conducted for the Facility pursuant to Section 121(c) of CERCLA (or the final review, if there are fewer than three reviews)] for 6 years after the Termination of this Decree: all records and documents in their possession, custody, or control which relate to the performance of this Consent Decree, including, but not limited to, documents reflecting the results of any sampling, tests, or other data or information generated or acquired by

any of them, or on their behalf, with respect to the Facility [and all documents pertaining to their own or any other person's liability for response action or costs under CERCLA]. After this period of document retention, Settling Defendants shall notify U.S. DOJ, U.S. EPA and the State at least ninety (90) calendar days prior to the destruction of any such documents, and upon request by U.S. EPA or the State, Settling Defendants shall relinquish custody of the documents to U.S. EPA or the State.

[46.] 45. Settling Defendants may assert business confidentiality claims covering part or all of the information provided in connection with this Consent Decree in accordance with Section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7), and pursuant to 40 [CFR §] C.F.R. § 2.203(b) and applicable State law. Information determined to be confidential by U.S. EPA will be afforded the protection specified in 40 [CFR] C.F.R. Part 2, Subpart B and, if determined to be entitled to confidential treatment under State law by the State, afforded protection under State law by the State. If no such claim accompanies the information when it is submitted to U.S. EPA and the State, the public may be given access to such information without further notice to Settling Defendants.

[47] 46. Information acquired or generated by Settling Defendants in performance of the Work that is subject to the provisions of Section 104(e)(7)(F) of CERCLA, 42 U.S.C.

§ 9604(e)(7)(F), shall not be claimed as confidential by Settling Defendants.

[48.] 47. In the event that Settling Defendants' obligation to produce documents under this Section includes documents which are privileged from disclosure as attorney-client communications, attorney work-product or other privilege recognized by law, Settling Defendants may seek to withhold production of such documents to avoid improper disclosure. At the time production is requested, Settling Defendants must provide the United States and the State all information necessary to determine whether the document is privileged, including such information as is generally required under the Federal Rules of Civil Procedure. If the United States does not agree with the Settling Defendant's claim of privilege, Settling Defendants may seek protection of the documents from the Court.[Settling Defendants shall not withhold as privileged any information or documents that are created, generated or collected pursuant to requirements of this Decree, regardless of whether the document has been generated in the form of an attorney-client communication or other generally privileged manner.] Settling Defendants may not withhold as privileged any documents that are subject to the public disclosure provision of Section 104(e)(7)(F) of CERCLA, 42 U.S.C. § 9604(e)(7)(F).

XVI. [REIMBURSEMENT] STIPULATED CIVIL PENALTIES

[49. a. Within 45 days of the entry of this Consent Decree,] In consideration of the work schedule agreed to in this Consent Decree and the Scope of Work, stipulated civil penalties shall be as described below:

48. Settling Defendant shall pay stipulated civil penalties of \$100 per day for its submission of a deficient resubmittal progress report unless such failure is excused under the Force Majeure provisions of the Consent Decree.

49. Except for the stipulated civil penalties specified in paragraph 50, the Settling Defendant shall pay the following stipulated civil penalties for each failure to comply with the requirements of this Decree, including but not limited to all implementation schedules and performance and submission dates:

Period of Failure to Comply Penalty Per Violation

3rd through 5th day

\$100

6th through 20th day

500

21st day and beyond

\$1000

In no event shall the total of all stipulated penalties assessed under this Decree, including interest and other fees exceed 25% of the cost of activities specified in the SOW.

Settling Defendant shall pay all stipulated penalties upon demand by U.S. EPA unless Settling Defendant invokes the dispute resolution procedures set forth in Paragraph XIV of this Consent Decree.

50. Stipulated civil penalties shall accrue from the date scheduled for performance of a specific task unless excused, and will continue until the completion of the task.

51. If any event occurs that delays any performance under this Order, whether or not caused by a force majeure event, and if the Settling Defendants exercise best efforts to avoid or minimize the delay of any subsequent effects, then the deadlines for every directly affected subsequent deliverable shall be extended accordingly so Settling Defendants will not pay cumulative penalties.

52. Stipulated civil penalties shall not accrue during the dispute resolution period. If the District Court becomes involved in the resolution of the dispute the period of dispute shall end upon the rendering of a decision by the District Court regardless of whether any party appeals such decision. If the Settling Defendants do not prevail upon resolution, the Plaintiff has the right to collect all penalties which accrue prior to and after the period of dispute. If the Settling Defendants prevail upon resolution, no penalties shall be payable. [Settling Defendants shall pay Seventy-Five Thousand Dollars (\$75,000.00) to the EPA Hazardous

Substances Superfund, plus interest accrued on that amount since October 25, 1990, at the rate of interest specified in 31 USC 3717. Payment shall be delivered to the U.S. EPA, Superfund Accounting, P.O. Box 70753, Chicago, Illinois 60673 in the form of a certified or cashier check payable to "EPA Hazardous Substances Superfund," and referencing CERCLA Number K7 and DOJ Case Number 90-11-3-608. A copy of such check shall be sent to the Director, Waste Management Division, U.S. EPA, Region V and to the Assistant Attorney General, Environment and Natural Resources Division, U.S. Department of Justice, at the addresses provided in Section XXI (Notices). This payment is for reimbursement of past costs claimed by the United States in this action through May 31, 1990.

b. Settling Defendants shall pay to U.S. EPA the cost of conducting a Blood Lead study. The United States shall submit its claim for costs associated with the Blood Lead study as soon as practical after completion of the study. Payment shall be made in the manner describe in paragraph A above.

c. Settling Defendants shall pay within forty-five (45) days of the entry of this Consent Decree, dollars (\$) to the State for its past response costs. Payment shall be made by means of a check made payable to " " and delivered to the Attorney General of the State.

50. Settling Defendants shall pay all response costs incurred by the United States and the State after the date[s] set forth

in the preceding paragraph (hereinafter referred to collectively as "Future Response Costs"), including all Oversight Costs, all costs of access required to be paid pursuant to Section X hereof, and all costs incurred in enforcing this decree.

51. The United States and the State shall submit their claim[s] for Future Response Costs incurred up to the date of entry of the Decree as soon as practicable after entry of the Decree. Claims for Future Costs shall be submitted periodically by U.S. EPA, as practicable. Payments shall be made, as specified in para. 49 above, within 30 days of the submission of the above claims. Settling Defendants may inspect the United States' cost documentation upon request.

52. Settling Defendants may agree among themselves as to the apportionment of responsibility for the payments required by this Section, but their liability to the United States and the State for these payments shall be joint and several.]

[XVII. STIPULATED PENALTIES

53. Settling Defendants shall pay stipulated penalties in the amounts set forth below to the United States for each failure to complete any requirement of this Consent Decree and Section III of the SOW in an acceptable manner and within the time schedules specified in the SOW, the RD/RA Work]

[Plan or in other plans submitted and approved under this
Consent Decree.

PENALTY

UP TO UP TO OVER

30 DAYS 60 DAYS 60 DAYS

1. Blood Testing \$5,000 \$10,000 \$15,000

Program Plan

2. Quality Assurance \$5,000 \$10,000 \$15,000

Project Plan and \$5,000 \$10,000 \$15,000

Sampling and

Analysis

3. Home Inspection \$5,000 \$10,000 \$15,000

and Fugitive Dust

Control Plan

4. A Plan for \$5,000 \$10,000 \$15,000

Satisfaction of

Permitting and

Access Requirements]

[5. Air, Groundwater, \$5,000 \$10,000 \$15,000

and Soil Cover/Cap

Contngency Plans

6. Design Plans and \$5,000 \$10,000 \$15,000

Specifications

7. Cost Estimate \$5,000 \$10,000 \$15,000

8. Project Schedule \$5,000 \$10,000 \$15,000

9. Construction Quality \$5,000 \$10,000 \$15,000

Assurance Plan

10. Health and Safety \$5,000 \$10,000 \$15,000

Plan/Emergency

Contingency Plan

UP TO UP TO OVER

30 DAYS 60 DAYS 60 DAYS

\$10,000 \$15,000 \$20,000]

[11. Failure to meet each milestone for implementation of the Work specified in the Work Plan(s), as approved by U.S. EPA, which at a minimum shall include:

- a. Taracorp drum removal;
- b. consolidation of the SLLR Piles with the Taracorp Pile;
- c. excavation/removal of battery casing material from Venice and Eagle Park Acres;
- d. excavation/removal of contaminated soils from Area 1;
- e. excavation/removal of contaminated soils from Residential Areas, including Areas 2-8;
- f. completion of the cap on the Expanded Taracorp Pile;
- g. implementation of contingency plans;
- h. implementation of other contingency measure.

54. All penalties begin to accrue on the day after complete performance is due or the day a violation occurs, and continue to accrue through the final day of correction of the noncompliance or completion of performance. Any modifications of the time for performance shall be in writing and approved by U.S. EPA. Nothing herein shall prevent the simultaneous accrual of separate penalties for separate violations of this Consent Decree.

55. Following U.S. EPA's determination that Settling Defendants have failed to comply with the requirements of this]

[Consent Decree, U.S. EPA shall give Settling Defendants written notification of the same and describe the non-compliance. This notice shall also indicate the amount of penalties due. However, penalties shall accrue as provided in the preceding paragraph regardless of whether U.S. EPA has notified Settling Defendants of a violation.

56. All penalties owed to the United States under this Section shall be payable within 30 days of receipt of the notification of non-compliance, unless Settling Defendants invoke the dispute resolution procedures under Section XIV.

57.] Settling Defendants may dispute the United States' right to penalties or the stated amount of penalties [on the grounds that the violation is excused by the Force Majeure provisions of Section XIII or that it is based on a mistake of fact]. The dispute resolution procedures under Section XIV shall be followed for such a dispute. Settling Defendants shall request a specific determination at each stage of

[58. Neither the filing of a petition to resolve a dispute nor the payment of penalties shall alter in any way Settling Defendants' obligation to continue and complete the performance required hereunder.

59. Penalties shall continue to accrue as provided in para. 55 during the] dispute resolution [period, but need not be paid until the following decision points:] as to the issues

and items upon which they have prevailed and as to the amount of any stipulated penalties owed.

[a. If the dispute is resolved by agreement or by decision or order of U.S. EPA which is not appealed to this Court, accrued penalties shall be paid to U.S. EPA and IEPA within fifteen (15) days of the agreement or the receipt of U.S. EPA decision or order;]

53. If Settling Defendant fails to pay stipulated civil penalties, the Plaintiff may institute proceedings to collect the penalties.

[b. If the dispute is appealed to this Court, accrued penalties shall be paid to U.S. EPA and IEPA within fifteen (15) days of receipt of the Court's decision or order, except as provided in subparagraph c below;

c. If the District Court's decision is appealed by any party]

54. If the District Court's decision is appealed by the Settling Defendants, Settling Defendants shall pay all accrued penalties into an interest-bearing escrow account within fifteen (15) days of receipt of the Court's decision or order. Penalties shall be paid into this account as they continue to accrue, at least every sixty (60) days. Within fifteen (15) days of receipt of the appellate court decision, the escrow agent shall pay the balance of the account to U.S. EPA, IEPA, and/or to Settling Defendants to the extent that they prevail, as determined pursuant to the following paragraph.

60. Settling Defendants shall not owe stipulated penalties for any items upon which they prevail in dispute resolution. Settling Defendants shall request a specific determination at each stage of dispute resolution as to the issues and items upon which they have prevailed and as to the amount of any stipulated penalties owed.

61. Notwithstanding the above provisions, the Settling Defendants shall have the right to petition the Court or U.S. EPA (according to the level of dispute resolution reached) for forgiveness of stipulated penalties that accrue during dispute resolution for items upon which they did not prevail, based on a finding (1) that the delay in work or other violation that caused the stipulated penalty to accrue was necessary and appropriate during the dispute resolution proceeding (2) that Settling Defendants' position regarding the dispute had substantial support in law and fact and reasonably could have been expected to prevail, considering the applicable standard of review, and (3) that Settling Defendants sought dispute resolution at the earliest practicable time and took all other appropriate steps to avoid any delay in remedial action work as a result of the dispute. If the Court or U.S. EPA so finds, they may grant a appropriate reduction in the stipulated penalties that accrued during the dispute resolution period. Settling Defendants shall have the burdens of proof and persuasion on any petition submitted under this provision.]

[62.] 55. Interest shall begin to accrue on the unpaid balance of stipulated penalties on the day following the date payment is due. Pursuant to 31 U.S.C. § 3717, interest shall accrue on any amounts overdue at a rate established by the Department of Treasury for any period after the date of billing. A handling charge of ____ will be assessed at the end of each 30 day late period, and a six percent per annum penalty charge will be assessed if the penalty is not paid within 90 days of the due date. Penalties shall be paid as specified in para. 49 hereof.

[63. If Settling Defendants fail to pay stipulated penalties, the United States or the State may institute proceedings to collect the penalties. In any such proceeding, penalties shall be paid as provided in para. 49 above.

64. Notwithstanding any of the above provisions, U.S. EPA may elect to assess civil penalties and/or to bring an action in U.S. District Court pursuant to Section 109 of CERCLA to enforce the provisions of this Consent Decree. Payment of stipulated penalties shall not preclude U.S. EPA from electing to pursue any other remedy or sanction to enforce this Consent Decree, and nothing shall preclude U.S. EPA from seeking statutory penalties against Settling Defendants for violations of statutory or regulatory requirements.]

[XVIII] XVII. COVENANT NOT TO SUE

56. Except as provided in Paragraph 57, the Settling Defendant shall receive no release from liability as a result of any action performed pursuant to this Decree. The United States reserves the right to institute proceedings in a new action or to issue an Order seeking to compel the Settling Defendant to remediate any release from the Facility. Settling Defendants reserve all rights they may have to oppose and defend against such claims and actions and to assert any and all claims they may have against EPA and/or any person or government agency.

57. In consideration of actions which will be performed and payments which will be made by the Settling Defendant under the terms of the Consent Decree, and except [65. Except] as otherwise specifically provided [in the following paragraph or elsewhere]in this Decree [,] the United States [and the State covenant] covenants not to sue the Settling Defendants or its officers, directors, employees, or agents for "Covered Matters." "Covered Matters, shall [mean] include any and all claims available to the United States [under Sections] or the State for work performed or payments made by the Settling Defendant pursuant to this Consent Decree under sections 106 and 107 of CERCLA and Section 7003 of RCRA [relating to the Facility,], any claims for natural resources damages and any and all claims available [to the State under

state statute and common law nuisance. With respect to future liability, this covenant not to sue shall take effect upon certification by U.S. EPA of the completion of the remedial action concerning the Facility pursuant to Section XXVI below.]
under common law authority.

[66. "Covered Matters" does not include:

- a. Liability arising from hazardous substances removed from the Facility;
- b. Natural resource damages;
- c. Criminal liability;
- d. Claims based on a failure by the Settling Defendants to meet the requirements of this Consent Decree;
- e. Any matters for which the United States is owed indemnification under Section XIX hereof; or
- f. Liability for violations of Federal or State law which occur during implementation of the remedial action.
- g. Any release of hazardous substances not derived directly from operations conducted by NL Industries and/or Taracorp, Inc.
- h. Liability for areas where work is prevented from being performed due to the occurrence of a force majeure event.

67. Notwithstanding any other provision in this Consent Decree, (1) the United States reserves the right to institute proceedings in this action or in a new action or to]

[issue an Order seeking to compel the Settling Defendants to perform any additional response work at the Facility, and (2) the United States and the State reserve the right to institute proceedings in this action or in a new action seeking to reimburse the United States for its response costs and to reimburse the State for its matching share of any response action undertaken by U.S. EPA and/or the State under CERCLA, relating to the Facility, if:

a. for proceedings prior to U.S. EPA certification of completion of the remedial action concerning the Facility,

(i) conditions at the Facility, previously unknown to the United States or the State, are discovered after the entry of this Consent Decree, or

(ii) information is received, in whole or in part, after the entry of this Consent Decree, and these previously unknown conditions or this information indicates that the remedial action is not protective of human health and the environment; and

b. for proceedings subsequent to U.S. EPA certification of completion of the remedial action concerning the Facility,

(i) conditions at the Facility, previously unknown to the United States or the State, are discovered after the certification of completion by U.S. EPA, or]

[(ii) information is received, in whole or in part, after the certification of completion by U.S. EPA, and these previously unknown conditions or this information indicates that the remedial action is not protective of human health and the environment.

68. For purposes of subpara. a. of the preceding paragraph, the information received by and the conditions known to the United States and the State is that information and those conditions set forth in the Record of Decision (the "ROD") attached as Appendix 1 hereto or in documents contained in U.S. EPA's administrative record supporting the ROD. For purposes of subpara. b. of the preceding paragraph, the information received by and the conditions known to the United States and the State is that information and those conditions set forth in the ROD, the administrative record supporting the ROD, or in reports or other documents submitted to U.S. EPA pursuant to this Consent Decree or generated by U.S. EPA in overseeing this Consent Decree prior to certification of completion.

69. Notwithstanding any other provisions in this Consent Decree, the covenant not to sue in this Section shall not relieve the Settling Defendants of their obligation to meet and maintain compliance with the requirements set forth in this Consent Decree, including the conditions in the ROD, which are incorporated herein, and the United States reserves its rights]

[to take response actions at the Facility in the event of a breach of the terms of this Consent Decree and to seek recovery of costs incurred after entry of the Consent Decree: 1) resulting from such a breach; 2) relating to any portion of the Work funded or performed by the United States; or 3) incurred by the United States as a result of having to seek judicial assistance to remedy conditions at or adjacent to the Facility.

70. Settling Defendants hereby release and waive any rights to assert any claims against the United States or the State and any agency of the United States or the State relating to the Facility.

71.] 58. Nothing in this Consent Decree shall constitute or be construed as a release or a covenant not to sue regarding any claim or cause of action against any person, firm, trust, joint venture, partnership, corporation or other entity not a signatory to this Consent Decree for any liability it may have arising out of or relating to the Facility. The United States [and], the State and Settling Defendants expressly reserve the right to continue to sue any person, other than the Settling Defendants, in connection with the [Facility] activities required by this Consent Decree.Facility.

XVIII. CONTRIBUTION PROTECTION

59. The Court hereby finds that this Consent Decree has been negotiated in good faith and constitutes a resolution by the Settling Parties of their liability, including that

under CERCLA and Section 7003 of RCRA, to the United States and State for the covered matters of this Decree. The parties agree, and the Court hereby finds that settling defendants have resolved their liability to the United States within the meaning of Section 113(f)(2) of CERCLA and are not liable for claims for contribution arising out of any matters addressed in this Consent Decree.

XIX. INDEMNIFICATION; OTHER CLAIMS

[72.] 60. Settling Defendants agree to indemnify, save and hold harmless the United States, the State and/or their representatives from any and all claims or causes of action arising from the negligent acts or omissions of Settling Defendants and/or their representatives, including contractors and subcontractors, in carrying out the activities pursuant to this Consent Decree, except to the extent that an act or omission was directed by U.S. EPA or the State over the objection of Settling Defendants. The United States and the State shall notify Settling Defendants of any such claims or actions promptly after receipt of notice that such a claim or action is anticipated or has been filed. The United State and State agree not to act with respect to any such claim or action without first providing Settling Defendants an opportunity to participate.

61 [73]. The United States and the State do not assume any liability of Settling Defendants by virtue of

entering into this agreement or by virtue of any designation that may be made of Settling Defendants as U.S. EPA's representatives under Section 104(e) of CERCLA for purposes of carrying out this Consent Decree. The United States and the State are not to be construed as parties to any contract entered into by Settling Defendants in carrying out the activities pursuant to this Consent Decree. The proper completion of the Work under this Consent Decree is solely the responsibility of Settling Defendants.

[74] 62. Settling Defendants waive their rights to assert any claims against the Hazardous Substances Superfund under CERCLA or the State's Hazardous Waste Fund that are related to any costs incurred in the Work performed pursuant to this Consent Decree, and nothing in this Consent Decree shall be construed as U.S. EPA's preauthorization of a claim against the Superfund.

XX. INSURANCE/FINANCIAL RESPONSIBILITY

[75. For the duration of this Consent Decree, Settling] 63. (Financial Assurance Not Appropriate For These Activities.)

Defendants shall satisfy, or shall ensure that their contractors or subcontractors satisfy, all applicable laws and regulations regarding the provision of worker's compensation insurance for all persons performing work on behalf of Settling Defendants in furtherance of this Consent Decree. Prior to

commencement of the Work at the Facility, Settling Defendants shall provide U.S. EPA and the State with a certificate of insurance and a copy of the insurance policy. If Settling Defendants demonstrate by evidence satisfactory to the United States and the State that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, then with respect to that contractor or subcontractor Settling Defendants need provide only that portion of the insurance described above which is not maintained by the contractor or subcontractor.

76. Settling Defendants shall provide financial security, in the amount of \$25,000,000, in one of the forms permitted under 40 C.F.R. 264.145, to assure completion of the Work at the Facility.]

XXI. NOTICES

[77] 64. Whenever, under the terms of this Consent Decree, notice is required to be given, a report or other document is required to be forwarded by one party to another, or service of any papers or process is necessitated by the dispute resolution provisions of Section XIV hereof, such correspondence shall be directed to the following individuals at the addresses specified below:

As to the United States or
U.S. EPA:

- a. Regional Counsel
Attn: NL Industries/Tara-
corp-Granite City
Coordinator (5CS)
U.S. Environmental
Protection Agency
230 S. Dearborn Street
Chicago, Illinois 60604
- b. Director, Waste Management
Division

Attn: NL Industries/Taracorp
Remedial Project Manager (5HS-11)
U.S. Environmental Protection
Agency
230 S. Dearborn Street
Chicago, Illinois 60604
- c. Assistant Attorney General
Environment & Natural
Resources Division
U.S. Department of Justice
10th & Pennsylvania Ave., N.W.
Washington, D.C. 20530
Ref. D.J. # 90-11-3-608

As to the State of Illinois:

- a. Attorney General
State of Illinois
Attn: NL Industries/Tara-
corp-Granite City
Coordinator
- b. Director, Illinois
Environmental Protection
Agency

As to Settling Defendants:

XXII. CONSISTENCY WITH NATIONAL CONTINGENCY PLAN

[78.] 65. The United States and the State agree that the Work required by this Consent Decree and additional work if any, if properly performed, is consistent with the provisions of the National Contingency Plan.

XXIII. ENDANGERMENT AND EMERGENCY RESPONSE

[79.] 66. In the event of any action or occurrence [during] caused by the performance of the Work which causes or

threatens a release of a hazardous substance into the environment which presents or may present an imminent and substantial endangerment to public health or welfare or the environment, [Setting] Settling Defendants shall immediately take all appropriate action to prevent, abate, or minimize such release and endangerment, and shall immediately notify the RPM or, if the RPM is unavailable, the U.S. EPA Emergency Response Section, Region V, U.S. EPA. Settling Defendants shall take such action in accordance with all applicable provisions of the Health and Safety/Contingency Plan developed pursuant to the SOW and approved by U.S. EPA. In the event that Settling Defendants fail to take appropriate response action as required by this paragraph and U.S. EPA or the State takes such action instead, [Settling Defendants shall reimburse all costs of the response action not inconsistent with the NCP. Payment of such response costs shall be made in the manner provided in Section XVI hereof.] retain all remedies provided by CERCLA and other applicable laws.

[80] 67. Nothing in the preceding paragraph or in this Consent Decree shall be deemed to limit the response authority of the United States under 42 U.S.C. § 9604.

XXIV. COMMUNITY RELATIONS

[81.] 68. Settling Defendants shall cooperate with U.S. EPA and the State in providing information regarding the progress of remedial design and remedial action at the Facility

to the public.[As requested by U.S. EPA or the State,]
Settling Defendants shall be given the opportunity to
participate in the preparation of all appropriate information
disseminated to the public and in public meetings which may be
held or sponsored by U.S. EPA or the State to explain
activities at or concerning the Facility.

XXV. RETENTION OF JURISDICTION; MODIFICATION

[82] 69. Retention of Jurisdiction. This Court will
retain jurisdiction for the purpose of enabling any of the
parties to apply to the Court at any time for such further
order, direction, or relief as may be necessary or appropriate
for the construction or modification of this consent Decree, or
to effectuate or enforce compliance with its terms, or to
resolve disputes in accordance with Section XIV hereof.

[83.] 70. Modification. No material modification
shall be made to this Consent Decree without written
notification to and written approval of the parties and the
Court except as provided below or in Section VII (Modification
of the Scope of Work; Additional Work). The notification
required by this Section shall set forth the nature of and
reasons for any requested modification. No oral modification
of this Consent Decree shall be effective. Nothing in this
paragraph shall be deemed to alter the Court's power to
supervise or modify this Consent Decree.

XXVI. EFFECTIVE DATE AND CERTIFICATION OF COMPLETION
OF REMEDY

[84.] 71. This Consent Decree shall be effective upon the date of its entry by the Court[, except to the extent provided in para. 13 regarding the commencement of remedial design upon lodging.].

[85. Certification of Completion of Remedial Action.]

72. Termination and Satisfaction. The Settling Defendants' obligations to U.S. EPA and the State under this Consent Order shall terminate and be deemed satisfied upon the Respondents' receipt of written notice from EPA that the Respondents have demonstrated, to the satisfaction of EPA, that all the terms of the Consent Order have been completed. Respondents may petition EPA in writing for a written termination. If EPA does not respond to Respondents request within thirty (30) days after receipt of Respondents' letter, Respondents may invoke Section XIV, Dispute Resolution procedures.

[a. Application. When the Settling Defendants believe that the soil lead cleanup, the consolidation and capping of the Expanded Taracorp Pile, and all other elements of the work to be performed as stated in this Consent Decree and the Scope of Work have been completed and that a demonstration of compliance with Cleanup and Performance Standards has been made in accordance with this Consent Decree, they shall submit to the United States and the State a

Notification of Completion of Remedial Action and a final report which summarizes the work done, any modification made to the SOW or Work Plan(s) thereunder relating to the Cleanup and Performance Standards, and data demonstrating that the Cleanup and Performance Standards have been achieved. The report shall be prepared and certified as true and accurate by a registered professional engineer and the Settling Defendants' Project Coordinator, and shall include appropriate supporting documentation.

b. Certification. Upon receipt of the Notice of Completion of Remedial Action, U.S. EPA shall review the final report and supporting documentation, and the remedial actions taken. U.S. EPA, in consultation with the State, shall issue a Certification of Completion of Remedial Action upon a determination that Settling Defendants have completed the soil lead cleanup and the consolidation and capping of the Taracorp pile in accordance with]

73. Effect of Settlement. By entering into this Consent Order, or by taking any action in accordance with it, the Settling Defendants do not admit any of the findings of fact, conclusions of law, determinations or any of the allegations contained in this Consent Order, nor do Settling Defendants admit liability for any purpose or admit any issues of law or fact or any responsibility for the alleged release or threat of release of any hazardous substance into the environment. The participation of any Settling Defendant in

this Consent Order shall not be admissible against Settling Defendants in any judicial or administrative proceeding, except for an action by EPA or the State to enforce the terms of this Consent Order, or, actions to which U.S. EPA or the State is a party, which allege injury based, in whole or in part, on acts or omissions of [Decree and demonstrated compliance with Cleanup and Performance Standards, and that no further corrective action is required.

c. Post-Certification Obligations. Following Certification,] Settling Defendants [shall continue to monitor air, water, and cap or soil cover quality for a minimum of thirty (30) years, as described in the SOW.] in connection with performance under this Consent Order. However, the terms of this Consent Order and the participation of Settling Defendants shall [take remedial action pursuant to the remedial action contingency plan developed in the event that concentrations of contaminants in ground water or lead in air exceed applicable standards or established action levels.] be admissible in any action brought by any Settling Defendants to enforce any contractual obligations imposed by any agreement among them.

[86. Effect of Settlement. The entry of this Consent Decree shall not be construed to be an acknowledgment by the parties that the]It is the intent of the parties hereto that neither the terms of this Consent Order, including any allegation, finding, conclusion or determination set forth

herein, nor the act of performance hereunder, shall be used against Settling Defendants as a collateral estoppel in any other proceeding with EPA, the State, or with any other governmental agency, or with any other person.

By signing and consenting to this Consent Order or by taking any actions pursuant to this Consent Order, Settling Defendants do not concede that the activities required herein are necessary to protect the public health or welfare or the environment, or for any other reason; that the methodologies or protocols prescribed by applicable EPA guidance or described or noted herein or otherwise required by EPA for performance of work pursuant to this Consent Order are the only ones appropriate for the proper conduct of the activities required herein, or that a release or threatened release [concerned constitutes] of a hazardous waste or substance at or from the Facility, or any disposal of a hazardous waste or substance at the Facility, may present an imminent and substantial endangerment to the public health or welfare or the environment. [Except as provided in the Federal Rules of Evidence, the participation by any party in this decree shall not be considered an admission of liability for any purpose, and the fact of such participation shall not be admissible in any judicial or administrative proceeding (except a proceeding to enforce this decree), as provided in Section 122(d)(1)(B) of

CERCLA] Settling Defendants have agreed to this Consent Order to provide assistance to U.S. EPA and to avoid unnecessary conflict or litigation.

ENTERED this ____ day of _____, 1990.

U.S. District Judge

The parties whose signatures appear below hereby consent to the terms of this Consent Decree. The consent of the United States is subject to the public notice and comment requirements of Section 122(i) of CERCLA and 28 CFR 50.7.

UNITED STATES OF AMERICA

Frederick J. Hess
United States Attorney
Southern District of Illinois

By: _____

Assistant United States Attorney
Southern District of Illinois

By: _____

Richard B. Stewart
Assistant Attorney
General
Environment & Natural
Resources Division
U.S. Department of Justice
Washington, D.C. 20530

Date: _____

By: _____

Valdas V. Adamkus
Regional Administrator
U.S. EPA, Region V

Date: _____

By: _____

Steven Siegel
Assistant Regional Counsel
U.S. EPA, Region V

Date: _____

PEOPLE OF THE STATE OF ILLINOIS
Neil F. Hartigan, Attorney General

By: _____
Shawn W. Denney
First Assistant Attorney General

Date: _____

ILLINOIS ENVIRONMENTAL PROTECTION
AGENCY

By: _____
Bernard P. Killian
Director of the IEPA

Date: _____

The undersigned Settling Defendant hereby consents to the foregoing Consent Decree in U.S. v. [NL INDUSTRIES] TARACORP, Inc., et al.

NAME OF SETTLING DEFENDANT (Type)

Address

By:

Name of Officer (Type)

(Signature of officer)

Title

(Place corporate seal and
acknowledgment of authority of
officer to sign here)

If different from above, the following is the name and address of this Settling Defendant's agent for service of process:

Name

Address

Prior Notice to all parties shall be provided by Settling Defendant of any change in the identity or address of the Settling Defendant or its agent for service of process.

LIST OF APPENDICES

Appendix 1 - [Record of Decision

Appendix 2 -]Scope of Work

PRP COMMITTEE FOR THE NL INDUSTRIES/TARACORP SITE

Contact:

Dennis P. Reis
Sidley & Austin
One First National Plaza
Suite 5400
Chicago, Illinois 60603
Direct: (312) 853-2659

October 31, 1990

BY MESSENGER

Brad Bradley (5HS-11)
United State Environmental
Protection Agency
Remedial and Enforcement
Response Branch
230 South Dearborn Street
Chicago, Illinois 60604

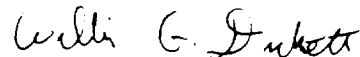
Re: NL Industries/Taracorp Site, Granite City, IL

Dear Mr. Bradley:

The parties identified on Supplement #1 to Attachment A have expressed an interest in joining the supplemental offer that was sent to you on October 24, 1990. Please add these parties to Attachment A of the October 24, 1990 offer.

If you have any questions or comments, please do not hesitate to call.

Very truly yours,



William G. Dickett

cc: Steven Siegel
Dennis P. Reis
Parties Listed on Supplement #1
to Attachment A

**SUPPLEMENT #1 TO
ATTACHMENT A**

SUPPLEMENTAL GOOD FAITH OFFER PARTICIPANTS

ADDITIONS

Intrametco

Ben Greenberg Company

Metro Metal Recyclers, Inc.

CORRECTIONS

Belson Scrap & Steel, Inc. was incorrectly listed as Beldon Scrap & Steel, Inc. on the Attachment A to the October 24, 1990 Supplemental Offer.

PRP COMMITTEE FOR THE NL INDUSTRIES/TARACORP SITE

Contact:

Dennis P. Reis
Sidley & Austin
One First National Plaza
Suite 5400
Chicago, Illinois 60603
Direct: (312) 853-2659

November 5, 1990

Brad Bradley (5HS-11)
United State Environmental
Protection Agency
Remedial and Enforcement
Response Branch
230 South Dearborn Street
Chicago, Illinois 60604

Re: NL Industries/Taracorp Site, Granite City, IL

Dear Mr. Bradley:

The parties identified on Supplement #2 to Attachment A have expressed an interest in joining the supplemental offer that was sent to you on October 24, 1990. Please add these parties to Attachment A of the October 24, 1990 offer.

If you have any questions or comments, please do not hesitate to call.

Very truly yours,

William G. Dickett

William G. Dickett

cc: Steven Siegel
Dennis P. Reis
Parties Listed on Supplement #2
to Attachment A

**SUPPLEMENT #2 TO
ATTACHMENT A**

SUPPLEMENTAL GOOD FAITH OFFER PARTICIPANTS

ADDITIONS

J.C. Penney

COMMITTEE CORRESPONDENCE

Address Writer at
ENVIRONMENTAL ACTIVITIES STAFF GENERAL MOTORS CORPORATION
GENERAL MOTORS TECHNICAL CENTER 30400 MOUND ROAD
WARREN MICHIGAN 48090-9015

December 13, 1990

Mr. Brad Bradley
U.S. Environmental Protection Agency
Office of Superfund
Remedial & Enforcement Response Branch
230 South Dearborn Street (SHS-11)
Chicago, Illinois 60604

Alan Held, Esq.
Department of Justice
Office of Enforcement
P.O. Box 7611
Ben Franklin Station
Washington, DC 20044

Post-It™ brand fax transmittal memo 7671		# of pages > 10
To <i>Steve Siegel</i>	From <i>Dan Ricknell</i>	
Co.	Co.	
Dept.	Phone #	
Fax #	Fax #	

Steven Siegel, Esq.
Assistant Regional Counsel
U.S. Environmental Protection Agency
230 South Dearborn Street (SCS-TUB-3)
Chicago, Illinois 60604

Re: NL Industries/Taracorp, Generator Class Carve-out

Gentlemen:

During our meeting with you last Friday, we received the clear indication that EPA-Region V was interested in a carve-out proposal which would include all viable generators. As we discussed with you on Friday, a generator Steering Committee and general PRP Committee meeting were both held on Monday. A good portion of both of those meetings was spent discussing the elements of a potential generator settlement. As you might expect, there was substantial concern with respect to: (1) acceptance of several aspects of the ROD, particularly the residential soil removal criteria; and (2) the allocation of responsibility between the generators and the owner/operator. Nevertheless, the participants at these meetings discussed several possible means of resolving these issues that could lead to a class settlement. The potential resolutions we discussed and a brief rationale underlying them are set forth below.

Let's Get It Together
SAFETY BELTS SAVE LIVES



The PRP Committee has attempted to have meaningful allocation discussions with NL Industries so that negotiations with EPA could go forward. However, NL Industries has resisted and in fact made no attempts to cooperate with the generators. NL Industries is currently in litigation with a number of generators over this question of owner-generator allocation. Clearly, NL Industries has for what ever reason not negotiated in good faith with the Committee and, consequently, foreclosed the possibility of a joint generator/owner good faith offer for RD/RA actions at this site. Moreover, its contention that as a viable past owner that it should require the generators to pay 90% of the costs for the remediation of an ongoing facility is not consistent with the basic objectives originally set out for the Superfund (i.e., to remediate abandoned toxic waste sites) or any sense of fairness. The generators see no possibility to reach an agreement with NL Industries on allocation or mechanisms to go forward in a settlement mode.

Despite the contentious nature of NL Industries and the fact that EPA has a strong case against this financially viable owner, the generators are attempting to negotiate a settlement in good faith with EPA to resolve our liability. The technical components of the ROD allow for the discrete segmentation of tasks in the remediation of this site. The group is offering to perform a substantial portion of the ROD remedy, which would expedite the clean-up of this site. Moreover, the generators are offering to do work in the areas of highest soil-lead, thereby immediately reducing any potential unacceptable risks to the public health, rather than take the tack of prolonged litigation. The acceptance of the generator carve-out offer by EPA would simplify any EPA litigation at this site.

The generators are making this carve-out offer despite the fact that NL Industries owned and operated the secondary lead smelter in a manner that caused the elevated levels of lead observed in the nearby area. The generators had no input into NL Industries functions and, considering the allocation case against NL Industries and its viability, are going far beyond what would required of the generators if the allocation issue is litigated.

All of the generators understand the need to establish a means to allocate a portion of the work and EPA's desire that the work commence. The main obstacle to fixing any percentage is the precedent it may set in terms of future site allocation or private party contribution litigation. Any settlement involving all of the generators will have to contain provisions making it clear that the generators have assented to the percentages for settlement purposes only. Also, the allocation would have to be subject to

change, if the generators or EPA find evidence that demonstrates that NL was both an owner/operator and generator. Finally, any generator must retain the right to sue NL for contribution. Because of the diverse views of the generators and NL Industries on allocation and the possibility that the volumetric shares understate NL's contribution, some safeguards are necessary.

The consensus of the Steering Committee is that the RI/FS performed by NL is deficient in several areas. Because of the concerns we have previously referenced and the absence of any discussion in the ROD of new techniques, in particular roto-tilling, it is the Committee's consensus that the RD investigation should include a tilling/liming pilot scale study. This alternative was not discussed in the FS, despite its acceptance by other regulatory bodies in similar situations. As noted in the December 7 meeting, the MPCA has adopted a State Rule recommending tilling of residential soils containing lead as the preferred remedial action. It is the belief of the Committee that this method provides a safer and more cost-effective way of addressing residential soils with contamination levels between 500 ppm and 1,000 ppm, while providing the same overall level of protection to the public health. We are researching various procedures or mechanisms to review the pilot scale study following completion, with the thought of finding one agreeable to you and the Committee. Any review must include a good faith commitment by the agency to reconsider remedial action depending upon the results of the pilot scale study. If the study is not convincing, the cleanup would proceed as set forth in the ROD consistent with the carve-out.

If the pilot study indicated that tilling with liming is a viable option, the group would propose using this method to remediate all residential site soils with lead levels above 500 ppm but less than 1,000 ppm to the performance standard in the ROD. For site soils greater than 1,000 ppm, excavation would be done to achieve the ROD's performance standard. This potential carve-out option may receive the full support of all the generators and is enclosed with this letter. Please note that the value of \$9,678,900 for the generator carve-out assumes two things: (1) that all the generators participate in the carve-out; and, (2) that roto-tilling is not part of the remedial action.

Enclosed is a revised ROD cost estimation which should reflect EPA concerns relative to the blood-lead survey, home interior inspections, and other contingency measures. This final cost projection may be used to craft a potential generator carve-out. The generator representatives at the December 7 meeting believe that EPA's agreement not to include specific units of work

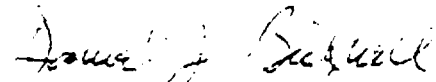
within the generator's carve-out (e.g., post-construction work, home interior inspections, or other contingency measures) will assist greatly in arriving at a settlement among all of the generators.

As with our discussions on Friday, please consider all of the above to be an informal presentation of various views for your consideration. The members of the PRP Committee have not had the time to consult their managements on the potential carve-out. Please review the carve-out and provide feedback by December 19.

We would request, in light of the preliminary and obviously sensitive nature of these negotiations, that this letter and our discussions pertaining to a potential settlement following issuance of the 106 Order not go beyond your agency.

Please contact me at (313) 947-1664 or Mark Hester at (313) 974-1552 at your earliest practical convenience.

Sincerely,



Daniel J. Bicknell

Enclosures

NL INDUSTRIES/TARACORP ROD COST ESTIMATION

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (Areas 1-3)	712	\$1,233 Areas 1-8; FS esti
Indirect Capital Costs (45%) Contingency (25%) Engineer (15%) Legal (5%)	1,032	
Bottom Liner	133	FS adj esti
Indirect Capital Cost (45%)	193	
SLLR Pile	109	FS esti
Indirect Capital Cost (45%)	158	
Contained Drosses	6.5	FS esti
Indirect Capital Cost (45%)	9.4	
Area 1	1,663	ROD esti
Indirect Capital Cost (45%)	2,411	
Area 2	1,603	FS esti
Indirect Capital Cost (45%)	2,324	
Area 3 (4,750 CY)	491	CY x \$103.3/CY
Indirect Capital Cost (45%)	712	
Other Costs	994	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Indirect Capital Cost (45%)	1,441	
Blood-Lead Survey	200	EPA esti
Alleys-Venice, Eagle Park, etc	748	FS esti 106 w/ 7 fold factor (?)
Indirect Capital Cost (45%)	1,085	
Eagle Park Acres Ditch	1,186	FS esti 118 w/ 10 fold factor
Indirect Capital Cost (45%)	1,719	

Annual O/M	53	FS esti 35
Indirect Capital Cost (45%)	77	For WP&Reports
Present Worth - 30 yr, 5%	1,177	
Air Monitoring	0.5	FS esti
Air Sample Analysis	8	FS esti
Groundwater Sampling	8.5	FS esti 1.8
Groundwater Analysis	14.3	Indi after yr 2
Site Mowing	6.5	FS esti
Site Inspection	2	FS esti
Misc Site Work/Repair	9	FS esti
Site Work Materials	4	FS esti

New Estimates Outside of FS

Area 4 (26,600 CY)	2,748	CY x \$103.3/CY
Indirect Capital Cost (45%)	3,985	
Area 5 (5,560 CY)	393	CY x \$103.3/CY
Indirect Capital Cost (45%)	570	
Area 6 (9,500 CY)	982	CY x \$103.3/CY
Indirect Capital Costs (45%)	1,424	
Area 7 (4,750 CY)	491	CY x \$103.3/CY
Indirect Capital Costs (45%)	712	
Area 8 (34,200 CY)	3,533	CY x \$103.3/CY
Indirect Capital Costs	5,123	
Extra Multi-layer Cap Area	521	FS adj esti
Indirect Capital Cost (45%)	756	
Additional Bottom Liner	534	FS adj esti
Indirect Capital Cost (45%)	774	
Other Costs	940	
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	500	FS esti 40
Equip't Decon	200	FS esti 40
Indirect Capital Cost (45%)	1,363	
Home Interior Inspections	231	\$150/house
Indirect Capital Cost (45%)	335	
Other Contingency Measures	104	see assumptions
Indirect Capital Cost (45%)	151	

Total 27,654

Total Costs do not include:
 Contingency Plans/Measures
 Remedial Design Investigation

Assumptions:

*Bottom liner - Alternative "E" FS cost estimate for total cost of pile + residential soils liner - \$1,259 X residential soil (98,567 CY) = \$667,270 for liner
resi and pile soils (183,567 CY)

*Residential soils-

-3" depth removal per FS cost estimate

-62.5% average surface area/block to be excavated per Enroserv Midwest 11/6/90 Report

-160,000 average sq.ft./block per Enroserv Midwest 11/6/90 Report

-950 average CY/block per Enroserv Midwest 11/6/90 Report

-98 total residential blocks in Areas 1 - 8 per Surdex 2/90 aerial photographs

-\$103.3/CY for residential soil remediation, which includes soil removal and replacement, trees/shrub replacement, and pavement cost.

*Monitoring wells-

-installation - 4 deep wells at 60 ft./well x \$60/ft. = \$14,400

-annual monitoring -

-collection-17 wells x 2 times/yr = 34 samples
x \$250/sample = \$8,500/yr

-analysis-34 samples + QA/QC = [43 samples x \$1,500/HSL analysis = \$64,500/yr x 2 yr = \$129,000/ 2 yr] + [43 samples x \$250/indicator analysis = \$10,750/yr x 28 yr = \$301,000] = \$430,000/30 yr = \$14,300/yr

***Home Interior Inspections -**

-XRF in-house inspection for lead sources (e.g., paint, plaster) at \$150/house (3 hrs/house at \$50/hr) x 1421 houses = \$231,150

***Other Contingency Measures -**

-driveway at average residence = 8' x 30' = 240 sq ft x 1421 houses = 341,040 sq ft

-assume that one out of five houses removes driveway = 341,040 sq ft / 5 = 68,208 sq ft as contingency.

-68,280 sq ft x 3" depth removal of soil = 27,283 cu ft / 27 cu ft/CY = 1010 CY x \$103.3/CY = \$104,383

Carve-out

Liability

* owner/operator - 65% liability

- \$27,654,000 total site cost x 0.65 = \$17,975,100; owner/operator share of total site cost. NL had its own separate lead collection operation, which generated about one-half of the total lead sent to the smelter. This 50% volumetric share is not reflected in the EPA ranking summary. This large NL generator share needs to be factored into an liability equation.

* generators - 35% liability

- \$27,654,000 (total site cost) - \$17,975,100 (o/o share)
= \$9,678,900; generator share of total site cost.

\$9,678,900 is the overall generator's share of the total remedy costs of \$27,654,000; if all the generators elect to participate in the carve-out.

* Viability Factor (VF) - to normalize % of potentially viable generator liability.

- A Viability Factor is to account for non-viable potential settlers, since a significant number of PRP generators are bankrupt or out of business. In numerical form it may be expressed as - % of total site amount x 1.466 (viability factor) = % of generator liability.

-The below computations are used to arrive at a VF for this site assuming that the entities noted as non-viable on the attached ranking summary are either bankrupt or out of business.

- 1st - 47th total generator % = 81.654%; yet only 65.586% is from viable parties.

- 48th - 362nd total generator % = 18.346%; yet only approximately one-seventh would be anticipated to be viable settlers. $18.346\% \times 0.143 = 2.624\%$; % of viable generators below 47th rank.

- 65.586% (% of viable generators 1st to 47th rank) + 2.624% (% of viable generators 48th to 362nd rank) = 68.210% as total % of viable generators.

- $VF = \frac{100\%}{68.210\%} = 1.466$; factor to normalize %

The viability factor is utilized to normalize the overall viable generators percentage of 68.210% to 100%. This is required to makeup for non-viable party percentages.

Carve-out

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (Areas 1-3)	712	\$1,233 Areas 1-8; FS esti
Indirect Capital Costs (45%)	1,032	
Contingency (25%)		
Engineer (15%)		
Legal (5%)		
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Contained Drosses	6.5	FS esti
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Area 2	1,603	FS esti
Indirect Capital Cost (45%)	2,324	
Area 3	491	CY x \$103.0/CY
Indirect Capital Cost (45%)	712	
Blood-Lead Survey	200	EPA esti
EPA past costs	200	
Cash	998.5	
Other Costs	994	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Indirect Capital Cost (45%)	1,441	
RD Invest.- Tilling Pilot Study	-	No cost
<u>Total</u>	<u>9,678.9</u>	

* If the RD cost estimate is < or > 10% of the \$ 27.7 million value, work may be added to or deleted from the above units to maintain a 35% generator carve-out.

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December 20, 1990

Mr. Brad Bradley
United States Environmental
Protection Agency
230 South Dearborn Street
(5HS-11)
Chicago, Illinois 60604

Re: NL Industries/Taracorp Granite City Site--
Comments to Administrative Order by
Johnson Controls, Inc.

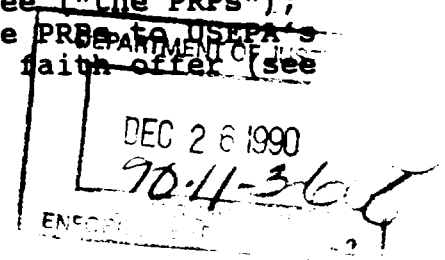
Dear Mr. Bradley:

As requested in paragraph 79 of the Administrative Order for Remedial Design and Remedial Action ("the Order") issued by the United States Environmental Protection Agency ("U.S. EPA") on November 27, 1990, we are submitting comments to the Order on behalf of our client, Johnson Controls, Inc. ("Johnson Controls").¹

I. INTRODUCTION

When amending the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") in 1986, Congress empowered U.S. EPA to select a remedy according to criteria set forth in the statute. To assure that cleanups were commenced expeditiously, Congress limited judicial review of the agency's remedy selection process to U.S. EPA's administrative record and to post-enforcement proceedings. It further dictated that the agency's decision would be considered erroneous only if arbitrary and capricious or otherwise not in compliance with law. Thus, if

¹ Johnson Controls also expressly incorporates into these comments the following documents previously submitted to U.S. EPA: (i) its March 12, 1990 comments to the proposed remedy; (ii) the August 31, 1990 good faith offer and exhibits submitted by the NL Industries/Taracorp Site PRP Committee ("the PRPs"); and (iii) the November 29, 1990 response by the PRPs to USEPA's September 14, 1990 rejection of the PRPs' good faith offer (see Exhibit A).



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U.S. EPA's decision-making process is carried out in a lawful manner, it is protected from close scrutiny. As a result, potentially responsible parties have great incentive to participate in whatever reasonable remedy the agency selected.

Conversely, the enormous power given to the agency, coupled with the substantial costs often incurred at Superfund sites, requires that U.S. EPA in good faith conform to accepted administrative procedures. At a minimum, the agency cannot predetermine an outcome. It must evaluate all the relevant evidence and reach a decision reasonably based on that evidence. Further, U.S. EPA must provide a decision document from which a party (and later a court, if necessary) can determine how the agency evaluated the evidence, why it reached the decision at issue, and whether it did so in a cost-effective manner.

The purpose of the comments is to demonstrate how and why the agency's decision is arbitrary and capricious and not cost-effective. In doing so, we will not rely on vague references to evidence, as did U.S. EPA; rather, we will extensively examine the administrative record.

The principal issue of contention at the Granite City site is the necessary cleanup level in residential soils.² U.S. EPA has chosen 500 ppm as a target level. We have looked at all the available evidence, whether or not contained in the administrative record, and completely fail to understand how, based on the evidence, the agency reached its decision. The perplexity exists on two levels. First, the great weight of the evidence we have examined, both in the administrative record and ignored by the agency, indicates that 1,000 ppm is protective of human health and the environment. Second, U.S. EPA's decision document fails to explain why it chose certain questionable statements contained in a very few documents in the record as credible support for a 500 ppm level and rejected the great weight of documents from which one should draw a different conclusion. While we understand that U.S. EPA has discretion to choose a remedy with a range of reasonableness, it cannot do so without providing a reasonable basis for the decision. Given the contradictory explanations provided to Johnson Controls in the Record of Decision ("ROD") (including attachments) and the September 14, 1990 rejection of the PRPs' good faith offer, the decision proves itself to be premeditated without regard to the evidence, arbitrary and capricious, and not otherwise in compliance with CERCLA.

² While there are other concerns, the potential impact of the cleanup level (no less than \$15 million) dwarfs them.

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As far as we can determine, U.S. EPA's argument can be expressed in a single sentence: lead is dangerous to a certain subset of children and to fetuses; thus, soil must be cleaned up to 500 ppm lead. The connection between the premise and conclusion is sorely lacking. There is nothing magical about the process U.S. EPA should follow in selecting a soil cleanup level. U.S. EPA must first determine the blood lead level at which adverse health effects occur. In the absence of an accepted level, at the very least U.S. EPA must determine a range and pick a target within the range. Second, U.S. EPA must determine the relationship between soil lead levels present at the site and blood lead levels in the surrounding population. Once U.S. EPA has determined this relationship, it can determine how a decrease in soil lead will impact blood lead levels and then choose a cleanup level which appropriately balances the likely effect with expected cost. Until it takes these simple steps, U.S. EPA has failed to properly choose a remedy at the Granite City site.

II. A CRITIQUE OF THE RESIDENTIAL SOIL REMEDY AT THE GRANITE CITY SITE

Along with several other parties, Johnson Controls commissioned an independent study of the administrative record to determine whether evidence existed to substantiate a 500 ppm cleanup level. We have included with these comments and expressly incorporate the accompanying report by TRC Environmental Consultants, Inc. ("TRC") (See Exhibit B). Before summarizing the report, however, we turn to the issue of the adverse health effects of lead.

A. Target Blood Lead Level

U.S. EPA apparently has not determined for purposes of the Granite City site the blood lead level at which adverse health effects will occur in the target population. Until recently, the scientific community has accepted the blood lead level associated with adverse health effects as 25µg/dl. However, some studies suggest a lower threshold, and U.S. EPA has expressed concern that lower blood lead levels may cause adverse health effects in children. U.S. EPA currently chooses to believe that the appropriate blood lead level of concern lies somewhere between 10µg/dl and 15µg/dl. However, U.S. EPA has not set forth any support in the ROD or the administrative record for lowering the target blood lead level to this range and has not yet determined where within this range the target should lie.

The unfairness of this procedure is evident in the administrative record. U.S. EPA noted in Appendix B of the ROD

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that a remedy which assured only 8% of the target population would exhibit levels above 15 μ g/dl would be acceptable. However, after the PRPs demonstrated in the August 31 good faith offer that the 1,000 ppm level adequately protected at the target blood lead level, U.S. EPA stated in its September 14 letter that 10 μ g/dl was a more appropriate target blood lead level. Even at that level, the 1,000 ppm standard is protective. To satisfy any semblance of due process, U.S. EPA should reasonably decide on an appropriate target blood lead level rather than changing positions every time it otherwise errs. U.S. EPA cannot rationally proceed to the determination of the relationship between soil lead levels and blood lead levels if it has not chosen the blood lead level at which adverse health effects occur.

B. Relationship Between Granite City Soil Lead Levels and Blood Lead Levels

After an appropriate target blood lead level is determined, U.S. EPA must then determine the relationship between soil lead levels and blood lead levels in the surrounding population before it selects an appropriate cleanup level for a lead-contaminated site. U.S. EPA failed to determine this relationship for the Granite City site.

TRC reviewed the Granite City ROD and associated administrative record for evidence relating to U.S. EPA's decision to select a remediation concentration of 500 ppm lead in soil. TRC's review focused upon the key arguments and citations used by U.S. EPA to justify the 500 ppm concentration. Additionally, TRC's review considered all other documents contained in the administrative record which considered the role of lead in soil, and its influence on children's blood lead concentrations.³

³ We note that U.S. EPA has failed to provide the PRPs timely access to all of the documents in the administrative record. The administrative record contains one document (Document 144, "Technical Support Document for Lead," October, 1989) which U.S. EPA, claiming confidentiality, initially had refused to provide to the PRPs even though U.S. EPA admitted that this document was considered in choosing the remedy. By the time U.S. EPA finally determined that it was incorrect in withholding the document and made the document available to the PRPs on December 20, 1990, there was insufficient time left in the comment period for the PRPs and their technical experts to adequately review the document. Due to U.S. EPA's unreasonableness in withholding this (continued...)

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The major conclusions of this investigation are as follow:

1. The administrative record does not contain any scientific evidence from which one could conclude that lead in soil in the 500 ppm to 1,000 ppm range is hazardous to young children.
2. Documents used directly by U.S. EPA to support the 500 ppm decision [OSWER interim guidance;⁴ a study by Mielke, et al. (1988) ("the Mielke study"); a study by Shellshear (1975) ("the Shellshear study"); and a study by Milar and Mushak (1982) ("the Milar and Mushak study")]⁵ were used inappropriately and are either not scientifically supported or represent only a small portion of the scientific evidence.
 - a. The OSWER interim guidance asserts that a remediation standard of 500 ppm to 1,000 ppm is suggested because, in this range, blood lead begins to show increases. However, this guidance is not supported by any quantitative experimental evidence, and it disregards the weak effect that soil lead has been shown to have on blood lead.⁶
 - b. The Mielke study contends that children are at risk at soil lead concentrations greater than 150 ppm, and it claims that the literature supports a major effect on blood lead in the range of 100 ppm to 600 ppm soil lead. However, the Minnesota study discussed in the Mielke study did

³ (...continued)

document, Johnson Controls reserves the right to submit comments on this document at a future date.

⁴ OSWER Dir. #9355.4-02.

⁵ See the TRC report (Exhibit B) for the full citations of these studies.

⁶ It should be noted that this document is a guidance document; it was not promulgated using formal rule-making procedures. Thus, the public did not receive an opportunity to comment on the document. Since the guidance document was drafted without public input, it is all the more important for U.S. EPA to clearly justify its decision in the ROD and the administrative record.

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not match children with soil except on a regional basis. In contrast, another study on a similar Minnesota population did match children and soil, and only a weak correlation could be established between soil lead and blood lead. The Mielke study also cites five other studies which TRC has found were not valid tests of the soil lead/blood lead relationship, and either did not support the Mielke study's central argument or were poor substitutes for better conducted studies.

- c. The Shellshear study and the Milar and Mushak study do not support the 500 ppm remediation standard because neither study is directly relevant to the issue. The Shellshear study focuses upon the unique subpopulation of children exhibiting pica whose exposure should be controlled by other means. The Milar and Mushak study considered house dust lead only, without measuring or even mentioning soil lead.
 - d. The supporting documents listed above tend to confuse the importance of soil lead and house dust lead, either by citing data relating dust lead (instead of soil lead) to blood lead or by ignoring the overriding importance of dust lead when correlating soil lead to blood lead. It is important to note that the contribution of soil to house dust lead appears to be small.
- 3. Evidence in the administrative record, but apparently not used by U.S. EPA in coming to its conclusion, indicates that lead in soil is, at most, a weak contributor to children's blood lead. A host of appropriately controlled studies indicate that an elevation of 1,000 ppm in soil lead might be expected to elevate blood lead by only 1.5-2.0 $\mu\text{g/dl}$. Therefore, the difference between a 500 ppm and a 1,000 ppm remediation standard with respect to resultant blood lead levels would be minor and possibly not measurable.
 - 4. U.S. EPA's use of the Lead Uptake Biokinetic ("U/B") model in Appendix B to the ROD is flawed.⁷ In the

⁷ Apparently realizing the it had no support in the administrative record for the 500 ppm standard, U.S. EPA added
(continued...)

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August 31 good faith offer, the PRPs demonstrated very significant errors in U.S. EPA's use of the U/B model, including the following: (i) U.S. EPA used obsolete rather than current U.S. EPA data on dietary lead sources, thus overstating blood leads related to soil lead; (ii) U.S. EPA failed to account for decreasing rates of human lead absorption with increasing levels of lead exposure, again overestimating blood leads; (iii) U.S. EPA failed to use site-specific concentrations of lead in household dust; and (iv) U.S. EPA failed to consider available calibration data from four other lead sites. U.S. EPA specifically stated in the ROD and Responsiveness Summary to the ROD that it relied on Appendix B, noting that "[d]ocumentation for the selection of this cleanup level is included in Appendix B." However, after U.S. EPA received the PRPs' August 31 good faith offer, it apparently realized that it had misused the U/B model in Appendix B and stated in response that it "did not rely on use of the biokinetic model in its selection of cleanup standards at the NL Site." Even now, U.S. EPA has not made up its mind as to the basis of the 500 ppm cleanup level. Thus, if U.S. EPA did not rely on the U/B model in Appendix B, then there is no basis in the record for the 500 ppm cleanup standard. To the extent U.S. EPA did rely on Appendix B, as noted in the PRPs' August 31 good faith offer, it did so incorrectly.

5. U.S. EPA did not use an appropriate site-specific approach to establish the remediation level for Granite City. The OSWER interim guidance states that site-specific factors need to be considered when deciding whether the lead in soil standard should be set near the lower or upper end of the 500 ppm to 1,000 ppm range.

- a. Several of the factors cited by U.S. EPA (i.e., residential nature of Granite City, unrestricted access by children to the residential area, and soil ingestion by children) are not unique to Granite City and were taken into account by OSWER when setting the range for residential areas at 500 ppm to 1,000 ppm. These factors merely demonstrate that the guidance range of 500 ppm to

⁷ (...continued)

Appendix B to the ROD after the public comment period. Thus, Appendix B was not part of the proposed plan subject to comment.

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1000 ppm of soil lead is the appropriate range to consider here; they provide no basis for selection of any point within the range because they are common to every site to which the range applies.

- b. The other factors cited by U.S. EPA (high bioavailability of lead in smelter dust and synergistic action of other industrial pollutants) are also not unique to Granite City and are vague assertions which only serve to confuse and mislead. The alleged high bioavailability of lead in Granite City soils is a theoretical argument. U.S. EPA has made no measure of the bioavailability of the soil at the Granite City site, nor has it considered the many other chemical and soil factors affecting the bioavailability of lead. In fact, the bulk of available data at smelter and urban sites indicates only a weak effect of soil lead on blood lead, which suggests low bioavailability or contact with soil,⁸ and the actual site-specific data for Granite City children does not show elevated blood lead concentrations. In addition, synergistic enhancement of lead's effects by other industrial pollutants is a completely unfounded argument. U.S. EPA does not cite what compounds to consider or any evidence that other contaminants synergize lead's toxicity. In fact, it is known that other metals can compete with lead for absorption and reduce lead's bioavailability and toxicity.

In summary, the central site-specific issues are: (i) whether or not current Granite City children's blood lead concentrations are elevated; and (ii) if elevated, what quantitative role does soil lead have, vis-a-vis other lead sources, in influencing blood lead concentrations. U.S. EPA failed to gather key site-specific information needed in order to develop a rational remediation decision for Granite City soils.⁹

⁸ In this regard, it should be noted that the OSWER interim guidance specifically states that "the Agency has not developed a position regarding the bioavailability issue . . ."

⁹ We note that one of the commenters to the ROD was Mr. Bobby G. Wixson, Dean of the College of Sciences, Clemson University, South Carolina. Mr. Wixson is the Chairman of the Society for
(continued...)

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U.S. EPA's 500 ppm remediation decision incorrectly predicts that there will be a substantial blood lead differential if soils are remediated to 500 ppm instead of 1,000 ppm, and its approach to estimating site-specific factors is overly generic and superficial. U.S. EPA completely disregarded valid quantitative approaches to setting a remediation standard (e.g., Uptake/Biokinetic Model using site-specific data) and, as a result, chose a remedy that was not cost-effective.¹⁰

III. U.S. EPA FAILED TO CONSIDER APPROPRIATE ALTERNATIVE REMEDIES

From its first entry into the Granite City area, Johnson Controls has sought to negotiate an appropriate course for remedial activities at the site. Noting the shortcomings in the record, the company offered to perform an environmental assessment of the Granite City area to address the relationship between soil lead and blood lead. More importantly, Johnson Controls offered to perform the remedy at the 500 ppm level if the study determined it appropriate. U.S. EPA did not consider the offer because the company refused to accept the deficient ROD.

In past weeks, the company again has explored other alternatives which could result in settlement. Believing that finding a cost-effective remedy is preferable to fighting about the agency's defective decision document, we suggested deep

⁹ (...continued)

Environmental Geochemistry and Health ("SEGH") Task Force on Lead in Soil. U.S. EPA is the funding agency for the SEGH Task Force and apparently commissioned the task force to determine guidelines for lead in soil. Mr. Wixson stressed in his comments that the task force remains convinced that a matrix approach to a site-specific location and population at risk be used rather than a single number or abatement approach applied to all sites. A draft of the SEGH Lead in Soil Task Force Recommended Guidelines recently was released confirming Mr. Wixson's belief that site-specific factors should be used in determining the appropriate cleanup level for a lead-contaminated site.

¹⁰ We note that paragraph 16 of the Order states that hazardous substances have and may continue to migrate through the air in the form of airborne emissions or dust. We also note that paragraph 26 of the Order states that the site "is or may be presenting an imminent and substantial endangerment to the public health or welfare or the environment." We are aware of no evidence to support these assertions.

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tilling and sodding as an alternative for soils in excess of 500 ppm but less than 1,000 ppm lead. Our initial study of the alternate remedy determined that it would cost at most one-third of the chosen remedy and perhaps lower depending on certain economies of scale. More importantly, it would reduce lead concentrations well below the 500 ppm level and would be a more permanent remedy than that U.S. EPA has chosen. Tilling also has considerable short-term advantages. It can be accomplished in a single year, does not endanger the neighborhood streets with heavy vehicles, causes little airborne particulate, and prevents complete disruption of the neighborhood.

In fact, the PRPs have documented evidence of the success of tilling in effectively reducing lead concentrations. In 1989, Exide Corporation, one the PRPs, contracted with WHO Manufacturing to perform soil cleanup and related remedial activities at Exide Corporation's facility in Selma, Alabama. The site was formerly used as a lead-acid battery manufacturing facility and regulated as a RCRA generator. Cleanup/remedial activities were performed by Exide on a voluntary basis and were based upon a plan submitted to the Alabama Department of Environmental Management (ADEM) and accepted in May 1988.

Decontamination objectives, as provided in the plan accepted by ADEM, were as follows:

1. To excavate contaminated soil (which exceeded an E.P. toxicity concentration of 5.0 mg Pb/l) and to dispose of the soil off-site,
2. For lesser contaminated soil (e.g., where E.P. toxicity concentrations were less than 5.0 mg Pb/l), to condition (till) the soil, and
3. Upon completion of items 1 and 2 above, to sample and analyze the soil (for total lead and E.P. toxicity for lead) in the areas where remedial measures were implemented to verify the success of remedial efforts.

Soil conditioning (tilling) was conducted in the lawn in front of the facility and in a surface drainage ditch located adjacent to the street in front of the facility. The attached sketch at the end of these comments shows the approximate location in which tilling was conducted. Surface soil samples were collected prior to and after remedial activities to evaluate the performance of the tilling process. Data from soil sampling are summarized as follows:

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Front Lawn

<u>Lead Concentration in Soil (ppm, dry weight)</u>		
<u>Sampling Location</u>	<u>Before Tilling</u>	<u>After Tilling</u>
3-A-4	1,162	127
4-3	2,769	71.6
2-3	374	126
1-3	1,120	438
6-A-6		136
5-A-6	Range from	4.5
7-3	481 - 6,488	66.5

Drainage Ditch

<u>Lead Concentration in Soil (ppm, dry weight)</u>		
<u>Sampling Location</u>	<u>Before Tilling</u>	<u>After Tilling</u>
8-A-4	3,350	22.1
9-A-5	1,699	107
10-A-4	3,055	29.4

A final report of the soil cleanup/remedial activities was submitted to ADEM by Exide Corporation on April 18, 1990. The substantial reductions in the soil lead levels above cannot be ignored.

Steven Siegel apparently has indicated that the remedy is mere dilution. Characterizing tilling in this manner results from a misunderstanding of basic science. As a nonradioactive, naturally occurring element, lead cannot and does not degrade through natural or man-made processes (high energy nuclear physics excepted), unlike many organic compounds often encountered at sites of concern. It becomes concentrated in the biosphere naturally through human use, and its concentration represents the material danger. The most immediate and permanent method for addressing such concentration is to reduce it, precisely what tilling like that discussed above accomplishes. We fail to see how creating a mountain of concentrated lead is preferable to our alternative.

The Minnesota Pollution Control Agency ("MPCA") has recently promulgated regulations stating that tilling is an acceptable remedial alternative for soil lead cleanup, and we understand another party has supplied you with them. While U.S.

Mr. Brad Bradley
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EPA has recently asserted that tilling was considered in the Remedial Investigation/Feasibility Study ("RI/FS") stage (although there is nothing in the record supporting this assertion), we understand U.S. EPA had previously told a PRP that it had not considered the method. Thus, we are at a loss regarding the agency's consideration of the issue. By ignoring a protective and cost-effective remedy, U.S. EPA failed to comply with the express requirements of CERCLA and the National Contingency Plan.¹¹

IV. U.S. EPA HAS IGNORED JOHNSON CONTROLS' DUE PROCESS RIGHTS

A. Johnson Controls was Added to the Process after U.S. EPA had Made its Decision

As evidenced during a December 18, 1990⁸⁹ meeting, U.S. EPA in fact made its decision about cleanup before it notified smelter site customers, including Johnson Controls, that they were PRPs at the site. By the time U.S. EPA asked Johnson Controls and other customers to participate, the RI/FS had been completed and modified by U.S. EPA. Customers of NL Industries then received a general notice letter in early December 1989, and, at the subsequent meeting on December 18, U.S. EPA informed the customers that they needed to organize a PRP group to implement the remedy U.S. EPA had already chosen. Further input on the company's part has been received without meaningful consideration. Johnson Controls has been deprived of the opportunity to play a meaningful role in the process and, as a result, also deprived of due process rights.

B. Johnson Controls did not Receive Proper Notice of the Comment Period

Johnson Controls did not receive proper notice of the comment period. Due process considerations require that reasonable notice be given to parties that may be affected by agency action. Johnson Controls and many of the other customers of NL Industries received written notice of the December 18, 1989 meeting with U.S. EPA through a general notice letter addressed to each individually. However, Johnson Controls never received comparable notice of the comment period which followed. Johnson Controls should have received notice of the comment period in a manner similar to the written notice it received for the December 18, 1989 meeting. Published notice was not sufficient because U.S. EPA had identified PRPs like Johnson Controls and knew their addresses. In fact, it is our understanding that U.S. EPA did

¹¹ It is not too late to give it the attention it deserves.

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not even publish notice in the Federal Register, the tool created over a half century ago to assure appropriate notice. By sheer accident, Johnson Controls found out about the comment period on the day it was extended, leaving insufficient time to reasonably respond to the proposed plan. Nevertheless, the company's comments did highlight the same shortcomings raised in this document -- problems which have yet to be cured.

C. The Deadlines in the Order are Unreasonable

The Order states that comments are due within 21 days of the issuance date or within 5 days of the conference with U.S. EPA, whichever is greater. U.S. EPA called counsel for Johnson Controls and told him that the conference would be held on December 21, making comments due on December 26. Given the Order carries with it draconian penalties for noncompliance, the deadline for comments is unreasonably short (and caused one to assume that the conference with U.S. EPA is not intended by the agency to serve any useful purpose other than to enable the agency to claim it had provided an opportunity to confer, meaningless as it may be). The deadline falls on the day after Christmas with an intervening weekend. Certain PRPs requested an extension until January 11 to submit comments to the Order on December 11, 1990, but the extension was rejected by U.S. EPA.

V. JOHNSON CONTROLS IS NOT A LIABLE PARTY UNDER CERCLA

The metal recycling business in the United States is centuries old. Customers of NL Industries and Taracorp brought materials to smelters for recycling, and such materials have served as raw materials long before any semblance of environmental control. Congress did not intend through CERCLA that such business relationships should be characterized as the arrangement for disposal or treatment of a hazardous substance. Consequently, smelter customers are not liable parties under CERCLA.

Mr. Brad Bradley
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VI. CONCLUSION

U.S. EPA's decision to remediate the soils in the residential areas to 500 ppm is arbitrary and capricious and not in compliance with law. With no pre-enforcement review and harsh penalties, CERCLA § 106 pushes the limits of due process. It is imperative that U.S. EPA properly justify and explain its remedial decision to ensure that a cost-effective remedy is chosen. U.S. EPA has cited studies which do not support its position and improperly used the U/B model. U.S. EPA has failed in this case to properly justify the 500 ppm standard for the Granite City site.

Very truly yours,

Dennis P. Reis

Dennis P. Reis

Enclosures

cc: Steve Siegel
Alan Held

PRP COMMITTEE FOR THE NL INDUSTRIES/TARACORP SITE

Contact:

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November 29, 1990

BY MESSENGER

Steve Siegel, Esq.
Office of Regional Counsel
U.S. Environmental Protection Agency
Region V (5CS-TUB-3)
230 South Dearborn Street
Chicago, Illinois 60604

Re: NL Industries/Taracorp Granite City Superfund Site

Dear Mr. Siegel:

I. Introduction

This letter is in response to EPA's September 14, 1990 letter from Mr. Norman Niedergang, in which EPA rejected the PRP Committee's (the "PRPs") August 31, 1990 good faith offer. The PRPs have waited until now to respond to EPA's September 14 rejection letter because we have been attempting to negotiate with you and Brad Bradley for the past several weeks. Since we have been unsuccessful and therefore unable to reach an agreement with EPA thus far, the PRPs believe it is now appropriate to respond to EPA's September 14 letter.

The September 14 rejection letter states that the primary reason that the PRPs' offer was rejected was that the offer failed to accept the 500 ppm cleanup standard. However, this is not completely true because the PRPs agreed that they would clean up the site to the 500 ppm level if the site-specific data on actual blood lead levels of residents and on environmental lead sources demonstrated that 500 ppm was the appropriate cleanup level. In any event, EPA has set forth no rational basis for choosing the 500 ppm cleanup standard. EPA stated in its Record of Decision ("ROD") that the 500 ppm cleanup standard was based on an EPA lead guidance document and on

Appendix B to the ROD. The EPA Lead Guidance¹ provides that the cleanup level of soil containing lead ranges from 500 ppm to 1000 ppm (perhaps higher or lower), depending on site-specific factors. However, as described more fully below, there was nothing in the record during the comment period which supported EPA's decision to choose the 500 ppm cleanup standard over another point within the 500 ppm - 1000 ppm range. Appendix B to the ROD, which discusses the use of the Lead Uptake/Biokinetic ("U/B") model, was added after the comment period. In any event, EPA states in the September 14 letter that it did not rely on the U/B model in choosing the cleanup level at the Granite City site, and thus there is no support in the record for its decision to use the 500 ppm standard. To the extent that EPA did rely on the U/B model, the PRPs showed in the August 31 good faith offer that EPA failed to properly consider the site-specific factors and specifically ignored the relationship between Granite City soil lead levels and potential blood lead levels in the surrounding population, the recognized indicator of an adverse health impact. The PRPs' August 31 good faith offer, on the other hand, proposed that this relationship be properly evaluated to determine the appropriate cleanup standard for the Granite City site.

II. The PRPs' Good Faith Offer

In the August 31, 1990 good faith offer, the PRPs offered to do virtually all of the work required by the ROD. Concerning residential soils, the PRPs agreed to clean up all soils having lead concentrations in excess of 1000 ppm whether or not site-specific data demonstrated any health risks based on those soil lead levels. In addition, the PRPs agreed to clean up below that level should site-specific data on actual blood lead levels of residents and on environmental lead sources demonstrate a health risk caused by lead in the soil. The PRPs offered to promptly gather such data, which would include blood lead sampling of Granite City residents to determine health risks from lead, and sampling of environmental sources of lead associated with the blood samples to determine the cause of any elevated blood lead levels. Environmental sampling for lead might include household dust, household paint, soil, air, and drinking water.

Residential soil cleanup, as now contemplated by EPA, involves bringing heavy excavating equipment into residential neighborhoods and digging up and removing the soil in each affected yard. The process is highly disruptive to residents; creates risk of injury, especially to children, associated with

¹ OSWER Dir. #9355.4-02.

the movement and operation of heavy equipment; and is costly to the PRPs. It also stirs up lead-contaminated dust which will be inhaled by residents and workers, increasing the health risk that the cleanup is supposed to mitigate. It is not known if these short-term risks are justified by the possible long-term benefits. In fact, it is our understanding that the feasibility study only considered soils with lead levels greater than 1000 ppm. Thus, with respect to soils with lead levels between 500 ppm and 1000 ppm, EPA has ignored the requirements of the National Contingency Plan ("NCP").²

III. EPA's Rejection of the Good Faith Offer

EPA's September 14, 1990 letter states that the PRPs' offer contained a number of misconceptions regarding the 500 ppm cleanup standard and how it was chosen and that the PRPs' offer was not a "good faith" offer because it did not accept the 500 ppm standard. However, as shown below, there is no support in the record for the 500 ppm cleanup level. Not only was Appendix B added to the ROD after the comment period, but EPA specifically stated in the September 14 letter that it did not use the U/B model in choosing the Granite City cleanup level, thus leaving nothing in the record supporting the 500 ppm standard. To the extent that EPA did rely on the U/B model, it failed to properly consider the relationship between Granite City soil lead levels and potential blood lead levels in the surrounding population.

A. Site-Specific Conditions

1. Lead Bioavailability and Effects on Children

In numbered paragraph 1 of the September 14 letter, EPA claims that the smelter operations in Granite City resulted in the emission of small, highly bioavailable particles and that low exposures to this form of lead have been shown to have significant health effects on children. However, EPA's claim begs the question of the quantitative relationship between soil lead levels and blood lead levels, the recognized indicator of adverse health effects. Furthermore, EPA has made no measure of the bioavailability of the soil lead at Granite City, nor has it considered the many other chemical and soil factors affecting the

² See 40 C.F.R. § 300.68 (1985) (old NCP); 40 C.F.R. § 300.430 (1990) (new NCP).

bioavailability of lead.³ In this regard, we note that the EPA Lead Guidance states that "the Agency has not developed a position regarding the bioavailability issue . . ."⁴

In addition, U/B model runs by TRC Environmental Consultants ("TRC") took into account lead bioavailability values supplied by EPA, which accounts for the high bioavailability of smelter emissions. TRC fine-tuned the U/B model to incorporate the best available soil lead absorption data and to incorporate the latest views of EPA's Office of Air Quality Planning and Standards ("OAQPS") concerning soil lead absorbability.⁵ OAQPS has worked extensively with the model to fine-tune and validate its predictive ability. Its guidance indicates that soil lead bioavailability decreases with increased concentrations of soil lead. As noted in Exhibit B to the good faith offer, TRC's analysis included a bioavailability assessment and concluded that even if one assumes that bioavailability is high, a soil lead concentration of 1000 ppm will not significantly affect blood lead levels in Granite City.

Furthermore, EPA's claim in numbered paragraph 1 of the September 14 letter that low levels of lead in soil would have adverse effects on children is based upon the assumption that even small changes in soil lead have a large impact on blood lead. However, EPA's assumption is without merit because the assumption is only valid under conditions in which the ambient lead level is also high.⁶ Studies conducted under conditions where ambient lead concentrations are low show much weaker, less dramatic association between soil lead levels and blood lead

³ Chaney, R.L., Mielke, H.W. and Starrett, S.B. 1988. Speciation, Mobility and Bioavailability of Soil Lead. In: Lead in Soil: Issues and Guidelines. Environ. Geochem. Health Monograph (Supplement to Vol. 9) pp. 105-129.

⁴ OSWER Dir. #9355.4-02.

⁵ U.S. EPA, Office of Air Quality Planning and Standards, 1989. Review of the National Ambient Air Quality Standards for Lead: Exposure Analysis Methodology and Validation - OAQPS Staff Report.

⁶ U.S. EPA, Environmental Criteria and Assessment Office, 1986. Air Quality Criteria For Lead, Volume III, Section 11.4.

levels.⁷ The difference between these two different types of situations is that ambient lead exposures will cause simultaneous elevations in soil and blood lead levels which will obscure the true relationship between these two measures. However, the shallow slope between soil lead levels and blood lead levels found under conditions of low ambient lead is more applicable to Granite City because Granite City does not have an ambient lead problem. Therefore, a 1000 ppm soil lead concentration will not significantly affect blood lead levels in Granite City.

2. Synergistic Effects of Other Industrial Pollutants on Lead Toxicity

In numbered paragraph 1 of the September 14 letter, EPA also claims that since Granite City is an industrialized area, toxicants unrelated to the smelter emissions will synergize lead's effects. EPA has not cited any data, nor do we know of any, which support this justification for setting the remediation concentration at 500 ppm. To the contrary, it is known that zinc salts, which may be present in polluted, industrialized areas, reduce lead's effects by interfering with lead absorption.⁸

3. Other Site-Specific Factors

EPA also claims in numbered paragraph 1 of the September 14 letter that 500 ppm is the proper cleanup standard because the soil contains elevated levels of lead, the site is a residential site, and children have unrestricted access to the residential area. However, these factors are factors that would exist at any residential site involving lead contamination and therefore would exist at every site to which the guidance

⁷ Bornschein, R., Clark, S., Pan, W., and Succop, P. 1990. Midvale Community Lead Study, Final Report.

Rabinowitz, M.B. and Bellinger, D.C. 1988. Soil-Blood Lead Relationship Among Boston Children. Bull. Environ. Contam. Toxicol. 41:791-797.

Stark, A.D., Quah, R.F., Meigs, J.W., and DeLouis, E.R. 1982. The Relationship of Environmental Lead to Blood-Lead Levels in Children. Environ. Res. 27:373-383.

⁸ Cerklewski, F.L. and Forbes, R.M. 1976. The Influence of Dietary Zinc in Lead Toxicity in the Rat. J. Nutri. 106:689.

applies. These factors merely demonstrate that the guidance range of 500 ppm - 1000 ppm of soil lead is the appropriate range to consider here. They provide no basis for selection of any point within the range because they are common to every site to which the range applies.

B. EPA's Use of the U/B Model

EPA states in numbered paragraph 2 of the September 14, 1990 letter that the PRPs misunderstood EPA's use of the U/B model. Despite EPA's use of the U/B model in Appendix B of the ROD, EPA claims that the U/B model has not yet been approved for use in setting cleanup levels at Superfund sites and that EPA did not rely on the use of the U/B model at the Granite City site. If EPA did not rely on the U/B model, then there is no basis in the record for EPA's decision to use a 500 ppm cleanup standard. Appendix B to the ROD was the only document in the record which attempted to discuss the relationship between soil lead levels and blood lead levels. Without the use of the U/B model, there is no basis in the record for the 500 ppm level.

EPA also claims in numbered paragraph 2 that, although it did not rely on the U/B model, it did consider it and concluded that the 500 ppm cleanup standard was appropriate. However, the PRPs' August 31 good faith offer demonstrated very significant errors in EPA's use of the U/B model to support its selection of a 500 ppm cleanup level. Specifically, the PRPs showed that:

- (1) EPA used obsolete rather than current EPA data on dietary lead sources, thus overstating blood leads related to soil lead;
- (2) EPA failed to account for decreasing rates of human lead absorption with increasing levels of lead exposure, again overstating blood leads;
- (3) EPA failed to use site-specific concentrations of lead in household dust.
- (4) EPA failed to consider available calibration data from four other lead sites.

The PRPs also demonstrated that, using current data, the U/B model estimates that exposure to 1000 ppm of soil lead in Granite City residential soils will not unsafely elevate children's blood lead levels.

C. The PRPs' Criticism of EPA's Use of the U/B Model

In numbered paragraph 4 of EPA's September 14 letter, EPA claims that the PRPs did not present their criticism of EPA's use of the model during the public comment period. It would have been impossible for the PRPs to comment on EPA's use of the model during that period because EPA's use of the model was not part of the proposed plan subject to comment; Appendix B to the ROD was added after the comment period. It makes no sense to say that the PRPs should have commented on EPA's use of the model during the comment period when EPA added the use of the model after such period. Furthermore, many of the PRPs never received notice of the comment period. The PRPs did receive notice of the December 18, 1989 meeting with EPA and reasonably expected that they would receive the same type of notice for the comment period. However, no such notice was received. Only a few of the PRPs found out about the comment period, and this was by accident and late in the comment period.

Numbered paragraph 4 of the September 14 letter also states that the lead study conducted in Midvale, Utah, discussed by the PRPs in the good faith offer, is flawed and thus prohibits its use in Region V. However, TRC utilized the Midvale data set because of the completeness of the raw data in providing blood lead and environmental lead data for an area formerly impacted by lead smelting and mining operations. EPA's criticism of the Midvale study for excluding children with the highest blood lead concentrations is a misunderstanding of the methods of Bornschein, et al. (1990).⁹ The exclusion of certain data was based upon methodological and statistical principles and did not introduce a bias in the data. This was demonstrated by the extensive analyses the authors did on the excluded data, in which they showed that the excluded and included data had no statistically significant differences between them. TRC's use of the Midvale data was merely to demonstrate that lead bioavailability decreases at high soil lead concentrations. The Midvale data set was supported by an analysis of four other

⁹ Bornschein, R., Clark, S., Pan, W., and Succop, P. 1990. Midvale Community Lead Study, Final Report.

smelter sites. Furthermore, EPA's own mode validation efforts¹⁰ support TRC's use of the Midvale data set and the U/B model.

EPA also claims in numbered paragraph 4 that a single blood-lead determination is not an appropriate basis for selection of a cleanup level. In support, EPA claims that a blood lead sample cannot show whether an elevated blood lead level results from a current exposure to lead or a past exposure to lead because even without current exposure, lead deposited in bone from past exposure will enter the bloodstream in measurable levels. EPA neglects to point out, however, that a blood lead study which reveals an absence of elevated lead in blood shows that there has been neither present nor recent past absorption of lead into the body.

Moreover, while it may be true that a single measurement of a single individual blood lead concentration may not be entirely reliable as a measure of that individual's exposure because nutritional and age-related factors may affect the resultant blood lead concentration, the same is not true of a community-wide sampling. Population blood lead concentrations are a good measure of community-wide exposure as shown by their constancy over several years¹¹ and by the good correlation between population blood lead and environmental lead in cases where the environmental lead burden has declined. If blood lead were not a reliable index of exposure, these correlations would be absent. In fact, the present blood lead level concentration at Granite City is likely to represent an overestimate of current exposure because, with lower ingestion rates, more lead is mobilized from storage sites in the body. Since the environmental lead burden has declined and will continue to decline at Granite City (as well as in most other regions of the U.S.), the community blood lead data obtained from a new study will represent a higher blood lead level than that which will occur in the future, even without a major soil remediation effort.

¹⁰ U.S. EPA, Office of Air Quality Planning and Standards, 1989. Review of the National Ambient Air Quality Standards for Lead: Exposure Analysis Methodology and Validation - OAQPS Staff Report.

¹¹ Rabinowitz, M.B. and Bellinger, D.C. 1988. Soil-Blood Lead Relationship Among Boston Children. Bull. Environ. Contam. Toxicol. 41:791-797.

D. Regression Analysis

Finally, numbered paragraph 5 of EPA's September 14 letter states that the PRPs cannot use the U/B model to do a "reverse regression" to determine appropriate soil lead levels based on blood lead levels. Here, EPA misunderstands the PRPs' offer. The PRPs simply propose to recalibrate the U/B model so that it reflects the actual relationship of measured levels of blood lead in Granite City to measured levels of various environmental sources at Granite City, and then to apply the model to determine the levels of blood lead that will result from changes in soil lead.¹²

IV. Conclusion

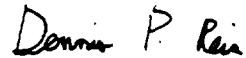
In sum, the 500 ppm standard was chosen without considering the relationship between soil lead levels and blood lead levels, the recognized indicator of adverse health effects. The PRPs' good faith offer, on the other hand, proposed to properly evaluate this relationship to determine the appropriate cleanup standard for the Granite City site. The PRPs recognize that setting an exact soil remediation level is a quantitative decision that must be based upon a great deal of site-specific data. The PRPs are committed to promptly obtaining the necessary data and offer such a study with full input from EPA. We do not agree that linear regression models cannot be used to describe a relationship between soil lead levels and blood lead levels. Rather, it is this relationship, which is currently not known for Granite City, that must be understood for the proper remediation concentration to be set.

¹² We note that the EPA Lead Guidance endorsed this type of calibration of the U/B model: "Use of the model thus allowed a more precise calculation of the level of cleanup needed to reduce risk to children based on the contamination from all other sources and the effect of contamination levels on blood-lead levels of children." OSWER Dir. #9355.4-02.

Steve Siegel, Esq.
November 29, 1990
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We hope the EPA will reconsider its decision and will agree to work with the PRPs toward a remediation of the Granite City site.

Very truly yours,

A handwritten signature in dark ink, appearing to read "Dennis P. Reis". The signature is written in a cursive, slightly slanted style.

Dennis P. Reis

DPR:ect

cc: Brad Bradley
PRP Group

INVESTIGATION OF THE GRANITE CITY
SUPERFUND RECORD OF DECISION AND
ASSOCIATED ADMINISTRATIVE RECORD
FOR EVIDENCE CONCERNING EPA
REGION V'S SOIL LEAD
REMEDATION STANDARD

Prepared for:

Sidley and Austin

Prepared by:

Gale F. Hoffnagle, CCM
Gary L. Ginsberg, Ph.D.

TRC Project No. 8084-R51

December 1990

TRC

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contrast, another study on a similar Minnesota population did match children and soil and only a weak correlation could be established between soil lead and blood lead. Mielke, et al. also cite five other studies which TRC has found were not valid tests of the soil lead/blood lead relationship, and either did not support Mielke, et al.'s central argument, or were poor substitutes for better conducted studies.

- c. The studies of Shellshear (1975), and Milar and Mushak (1982) do not support the 500 ppm remediation standard because neither study is directly relevant to the issue. Shellshear et al. (1975) focuses upon the unique subpopulation of children exhibiting pica whose exposure should be controlled by other means. Milar and Mushak studied house dust lead only, without measuring or even mentioning soil lead.
 - d. The supporting documents listed above tend to confuse the importance of soil lead and house dust lead, either by citing data relating dust lead (instead of soil lead) to blood lead, or by ignoring the overriding importance of dust lead when correlating soil lead to blood lead. It is important to note that the contribution of soil to house dust lead appears to be small.
3. Evidence in the Administrative Record, but apparently not used by EPA Region V in coming to its conclusion, indicates that lead in soil is, at most, a weak contributor to children's blood lead. A host of appropriately controlled studies indicate that an elevation of 1,000 ppm in soil lead might be expected to elevate blood lead by only 1.5-2.0 µg/dl. Therefore, the difference between a 500 and 1,000 ppm remediation standard with respect to resultant blood lead levels would be minor, and possibly not measurable.

In summary, Region V's 500 ppm remediation decision incorrectly predicts there to be a substantial blood lead differential if soils are remediated to 500 ppm instead of 1,000 ppm, and its approach to estimating site-specific factors is overly generic and superficial. The decision completely disregards valid quantitative approaches to setting a remediation standard (e.g., Uptake/Biokinetic Model using site-specific data). All available evidence indicates that an imminent health hazard does not exist in Granite City from lead remaining in soil, and that it is prudent to develop the data needed to finalize the soil remediation decision.

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APPENDICES

A	ADMINISTRATIVE RECORD INDEX: NL INDUSTRIES/ TARACORP, GRANITE CITY, ILLINOIS SITE
B	KEY DOCUMENTS AND CITATIONS INDEX

1.0 INTRODUCTION

EPA Region V's Record of Decision (ROD) for Granite City dictates that lead in soil in residential areas be remediated to 500 ppm. TRC Environmental Consultants has studied the arguments and evidence put forth by Region V to substantiate this decision. Region V's rationale for the soil lead standard can be found in the ROD and associated documents, most notably 1) Appendix B of the ROD ("Selection of a Lead Soil Clean-Up Level for the NL/Tara Corp. Superfund Site"); 2) Appendix A of the ROD (NL Industries/Tara Corp.; Granite City, Illinois; Responsiveness Summary); 3) letter from Brad Bradley, Region V, to Stephen Holt, NL Industries, dated 12/27/88 indicating Region V's approval of the Remedial Investigation (RI) report, but with substantial revision; and 4) letter from Norman Niedergang, Office of Superfund, to Dennis Reis, Sidley & Austin, received on 9/14/90, rejecting the PRP Committee's "good faith" offer.

Section 2 of this report examines the scientific basis for the assertions and judgments made by Region V concerning soil lead's impact on blood lead. Examination of the ROD uncovered 6 distinct arguments used by Region V to justify the soil lead decision. These arguments are the focus of Section 2.

Section 3 of this report is an analysis of all documents contained in the Administrative Record, which might have, based upon the way in which they were listed on the docket, had a bearing on the 500 ppm soil lead remediation decision. By thoroughly examining the supporting documents underpinning the soil lead decision, this report endeavors to determine how strong the scientific evidence is for the decision, as documented in the ROD.

2.0 SCIENTIFIC BASIS FOR REGION V'S JUSTIFICATION OF A 500 PPM CLEAN-UP STANDARD FOR GRANITE CITY

2.1 Low Level Effects of Lead in Young Children and In Utero

Region V states that relatively low blood lead levels, 10-15 µg/dl for young children and 10 µg/dl for in utero exposures, may be associated with adverse developmental and/or neurological effects. The assertion is also made that "even low exposures to lead have been shown to have significant health effects on developing children, especially those under the age of six years". The implication is that a 500 ppm remediation standard is required and sufficient to maintain blood lead levels in a protective range for children (10-15 µg/dl) and for women of child-bearing age (10 µg/dl). Two types of evidence to support this assertion could be found in the Administrative Record, both summarized by Region V in Appendix B of the ROD. The first type of evidence is studies cited by Region V which provide evidence regarding soil lead's effect on blood lead. The second type of evidence is the OSWER interim guidance (EPA, 1989a) on soil lead cleanup decisions for Superfund sites, and the site-specific factors Region V chose to consider for Granite City. These lines of evidence are examined in the following sections.

2.1.1 Experimental Literature Cited by Region V to Support the Need for a 500 ppm Remediation Standard

Region V claims that "researchers in the field" echo EPA's conclusion that a 500 ppm standard is needed for soil lead. They cite Milar and Mushak (1982), Mielke, et al. (1988), and Shellshear (1975), in this regard. Each of these studies are reviewed below.

Milar and Mushak, 1982

Region V states that "Milar and Mushak (1982) warned that a definite health hazard exists to children when household dust levels exceed 1,000 ppm or 50 micrograms per square meter".

While the study contains this quote, this does not constitute support for Region V's soil lead decision. Milar and Mushak studied blood lead in relation to house dust lead, and not once did they measure soil lead or mention any relationship of their data to lead in soil. By studying 17 children living in homes with elevated house dust lead due to parental occupation (i.e., work clothing contaminated with lead), and 30 children from non-impacted homes, they found that children living in homes with house dust lead averaging 250 ppm had a mean blood lead level of 18 $\mu\text{g}/\text{dl}$. However, the group of impacted children lived in homes with a mean house dust lead of approximately 3,000 ppm, and they had a mean blood lead level of 44 $\mu\text{g}/\text{dl}$.

Milar and Mushak (1982) also followed the blood lead of children whose homes had been remediated with respect to house dust lead levels. They report that "In all cases, reduction of the lead content of house dust resulted in an almost immediate decline in the lead burden." They provide, as an example, nine month follow-up data for one child whose house dust lead levels were reduced from approximately 8,000 to 2,000 ppm. This decline was matched by a dramatic decline in the child's blood lead from 52 to ~ 20 $\mu\text{g}/\text{dl}$. While this blood lead response may have been affected by behavioral changes due to a greater awareness of the problem, Milar and Mushak's data are a clear indication that remediation of house dust lead is effective in lowering children's blood lead.

The house dust lead/blood lead relationship described by Milar and Mushak (1982) is not surprising, and has very little relevance to the blood lead response to soil lead. As discussed in Section 2.1.3, indoor dust lead has a much greater effect on blood lead than does soil lead. This is largely due to the greater amount of time spent indoors, with concomitantly greater exposure to house dust relative to soil (Duggan, 1983; EPA, 1989b). The effectiveness of house dust remediation in alleviating a blood lead problem in children is

clear evidence for the overriding importance of house dust lead (Charney, 1983; Milar, 1982). Therefore, the data relating blood lead to house dust lead is not useful for establishing a soil lead/blood lead relationship, or for setting a soil lead remediation standard. It can be expected that the soil lead impact on blood lead will be considerably less dramatic than what was found in Milar and Mushak's study of house dust lead (e.g., Charney, 1980).

The data sets and the superficial analysis thereof provided by Milar and Mushak, do not allow an extrapolation to an acceptable house dust lead level. Where in the range between 250 and 3,000 ppm house dust begins to have a measurable and significant effect on blood lead is not documented by these authors. They cite a similar study by Baker, et al., 1977 which they purport demonstrates an elevation of childhood blood lead levels if house dust rises above 1,000 ppm. The Baker study is reviewed under Section 3.0, Document 69; it is worth mentioning here that there were only 5 children in the 1,000-2,000 ppm dust range level on which to base this deduction about a house dust lead cutoff. Milar and Mushak recognize the limitations of their data and that of others by stating "at the present time there are not enough samples from a sufficiently wide range of children to determine the overall quantity of lead per unit surface area ($\mu\text{g}/\text{m}^2$) in the home environment which constitutes a hazard". EPA disregarded the uncertainty and incompleteness in Milar and Mushak's study as they used it to support their contention. Further, EPA did not recognize the fundamental distinction between house dust and soil lead in contributing to blood lead.

Mielke, et al. (1988)

Region V quotes from a literature review section of this article the statement that "a rapid rise in population blood lead levels takes place when the lead content of soil increases from less than 100 to 500-600 ppm". This

statement along with reference to a personal communication from Dr. Mielke that a safe lead soil level is 200-250 ppm, constitutes the major literature evidence cited for the need to remediate to 500 ppm in soil. The Mielke, et al. (1988) paper is also Document 106, and is therefore reviewed in detail in Section 3. TRC's investigation of the scientific basis for these key assertions is summarized below.

The personal communication by Mielke stating an appropriate soil lead clean-up level represents a statement of opinion which cannot be verified or examined for scientific credibility, because the experimental basis (if any) for this statement is not known. Dr. Mielke has not stated this recommendation in any publication. His recent publication on Minnesota children (Mielke, et al., 1988) could be taken as support for this recommendation since the conclusion is reached that "when 40% of the soils exceed 150 ppm, then the population of children no longer appears to have a sufficient margin of safety to prevent a portion of the children from exhibiting lead toxicity". However, this conclusion is an over-interpretation of the data presented, and does not take into account the severe limitations of the study.

Mielke, et al. (1988) demonstrated a general correlation between regions of Minnesota with elevated soil lead levels, with elevations in the blood lead levels of children. However, their data was not pair-matched, i.e., the soil lead data was not derived from the residences in which the children whose blood was surveyed lived. In effect, Mielke, et al., did not know the soil lead value for particular children, but simply assigned regional soil lead values to groups of children. Any correlations generated from non-pair-matched data need to be verified by a pair-matched study, especially if the goal is to determine which range of soil lead levels can make a substantial contribution to blood lead.

A pair-matched study of a similar Minnesota population of children, sampled by the same state agency at the same point in time, found only a weak relationship between soil lead and blood lead, sharply contrasting with Mielke, et al.'s conclusions (Trippler, 1988). Therefore, use of the unpaired data set by Mielke, et al. was a contributing factor leading these researchers to an erroneous conclusion regarding the importance of soil lead in causing elevations in blood lead (see Section 2.1.2).

Other factors which Mielke, et al. ignored in their analysis are the role of house dust, condition of housing (with regards to flaking paint), socio-economic status, and behavioral parameters (e.g., child's mouthing behavior) in determining blood lead. Attempting to study soil lead's impact on blood lead without considering these other risk factors strongly biases the study towards assigning a major role to soil lead. These considerations, combined with the conflicting data from the pair-matched data set, dictate that the results and conclusions of Mielke, et al. (1988) cannot be used to support any particular soil lead remediation decision.

Mielke, et al. (1988) seek to support their statement regarding a rise in population blood lead as soil lead increases from less than 100 to 500-600 ppm by citing Angle (1982), Bornschein (1986), Brunekreef (1981), Reeves (1982), and Vimpani (1985). These studies are reviewed, in detail, in Section 3.12. Mielke, et al. attempted to select studies which demonstrated an effect on blood lead at very low soil lead levels. However, as the review in Section 3 indicates: 1) the Vimpani (1985) study was very weak and actually contradicts Mielke et al.'s key assertion; 2) the Reeves (1982) study is also very weak, in that it lacks important controls, and even so, the data are contradictory with regards to a low level soil lead effect on blood lead; 3) the Brunekreef (1981) data suggest an important relationship between soil lead and blood lead only in a select subgroup of the studied population, and this relationship

does not appear to be statistically well tested; 4) the Bornschein (1986) data indicate that soil lead was not statistically significantly related to blood lead, but yet they infer a steep relationship between soil lead and blood lead which they do not test; and 5) the Angle (1982) data is severely flawed by the lack of adequate controls and pair-matching, and a more thorough re-analysis of these data (Angle, 1984) which was ignored by Mielke, et al., demonstrated a much different soil lead/blood lead relationship than the one chosen by Mielke, et al.

Shellshear, et al. (1975)

Region V cites this study to support the contention that "children exposed to more than 100 ppm lead in soil and who also exhibit pica, are at major risk to lead exposure."

The Shellshear, et al. (1975) study predictably found that pica children have elevated blood lead levels, but these authors did not adequately characterize these children with respect to indoor dust lead and lead paint hazards. Since indoor lead sources are important contributors to blood lead, it is inappropriate to attribute the pica-related increase in blood lead solely to the ingestion of soil lead. The high exposure to lead in soil possible for children exhibiting pica indicates that even low background levels of lead in soil may present a blood lead problem (Shellshear, 1975). Therefore, it is unrealistic to base community-wide soil remediation decisions on the unique problem of excessive soil exposure due to pica.

In summary, the literature references cited by Region V to support their contention that a low soil lead remediation standard is necessary are inconsistent and, at best, provide only weak evidence for a major effect of soil lead on blood lead. The Milar and Mushak (1982) study is not relevant to the soil lead/blood lead issue since it only addresses lead in house dust, the Mielke, et al. (1988) study and the studies cited therein are generally very poorly controlled and were cited inappropriately, and the Shellshear, et al. (1975) reference is not relevant to soil lead remediation because of its focus on pica children and its failure to account for other sources of lead exposure.

2.1.2 Experimental Evidence Not Used by Region V Which Determined Soil Lead's Effects on Blood Lead

In contrast to the weak evidence in favor of a strong soil lead/blood lead relationship, there is ample data to support the concept that soil lead has only a minor effect on blood lead, which would require a less restrictive soil lead remediation standard. In a review of the soil lead/blood lead literature, Elwood (1986) concluded that:

"in most studies no significant relationship between soil lead and blood lead seems to have been detected, and in those in which it has, the estimates of the relationship have varied enormously. This is disappointing for those who wish to define standards for use in land reclamation activities. However, the studies which have depicted an increase suggest that the hazard of soil lead is not very great."

Elwood attributed the weak relationship between soil lead and blood lead to the relative remoteness of soil, and stated that dust lead, which is a more important contributor to blood lead, is primarily derived from internal rather than external (e.g., soil) sources of lead.

The Lead Criteria Document (EPA, 1986) details various studies which demonstrated a correlation between soil lead and blood lead. EPA summarized the soil lead/blood lead relationship in terms of slope factors, i.e., the change in blood lead ($\mu\text{g}/\text{dl}$) per 1,000 ppm change in soil lead. Their summary table, reproduced here (Table 2-1), indicates that a variety of soil lead/blood lead slope values have been found, ranging from 0.6 $\mu\text{g}/\text{dl}$ to 7.6 $\mu\text{g}/\text{dl}$ per 1,000 ppm change in soil lead. However, the two highest slope factors found, those from the Omaha and British Columbia studies, were poorly controlled studies in that the data were not pair-matched. In other words, the soil lead and other environmental lead data were not taken from the same residences where the measured children lived. In the other four studies from Connecticut, Idaho, South Carolina, and England, the environmental lead and blood lead data were pair-matched, and low slope factors were obtained. It is

Table 2-1

ESTIMATES OF THE CONTRIBUTION OF SOIL LEAD TO BLOOD LEAD

Study	Range of soil lead values (µg/g)	Depth of sample	Estimated slope (X10 ³)	Sample size	R ²
Angle and McIntire (1982) study of children in Omaha, NE	16-4792	2"	6.8	1075	0.198
Stark et al. (1982) study of children in New Haven, CT	30 - 7000 (age 0-1)	½"	2.2	153	0.289
	30 - 7600 (age 2-3)		2.0	334	0.300
Yankel et al. (1977) study of children in Kellogg, ID	50 - 24,600	¾"	1.1	860	0.662
Galke et al. (1975) study of children in Charleston, SC	9 - 7890	2"	1.5	194	0.386
Barltrop et al. (1975) study of children in England	420 - 13,969 (group means)	2"	0.6	82	NA*
Neri et al. (1978) study of children in British Columbia	225-1800 (group means, age 1-3)	NA	7.6	87	NA
	225-1800 (group means, age 2-3)	NA	4.6	103	NA

*NA means Not Available.

important to note that these four studies represent a variety of different types of lead exposures, including lead releases from a smelter, urban pollution/auto exhaust and mining operations.

Therefore, it appears that when blood lead levels are correlated to environmental lead inputs on a case-by-case, pair-matched basis, the influence of soil lead on blood lead is found to be minor. This conclusion is supported by the major difference in results found in the Mielke, et al. (1988) study using an unpaired data set, compared to those of Trippler, et al. (1988), who studied a similar population, but used a pair-matched data set. Further, the Bornschein, et al. (1990) Midvale data set, which was very carefully controlled and pair-matched, also found a very low slope between soil lead and blood lead. Finally, the recent pair-matched study conducted by Rabinowitz and Bellinger (1988) on 195 Boston children found low soil lead to blood lead slope factors: for children with low mouthing behavior, the slope was 0.6 $\mu\text{g}/\text{dl}$ per 1,000 ppm increase in soil lead; for children with increased mouthing behavior, the slope was 1.6 $\mu\text{g}/\text{dl}$ per 1,000 ppm.

It is not surprising that the unmatched studies derive a higher slope factor than the pair-matched studies. A bias is introduced into the correlational analysis by assigning a single, regional soil lead value to a range of blood lead values. The full variability inherent in soil lead results is not expressed, which quenches the range of soil lead values available to explain the full variance in blood lead. Thus, an unrealistically small range of soil lead levels is forced into correlation with a larger set of blood lead data, yielding the inevitable result that moderate changes in soil lead produce unreasonably large changes in blood lead. Conversely, pair-matched studies are much more realistic in that a child's actual environmental lead sources are correlated with his/her blood lead result. This allows for the expression of the full variance in soil lead

which corresponds to the variance in blood lead, leading to a reasonable estimate of the soil lead/blood lead slope.

The mean slope for the soil lead to blood lead relationship appears to be 1.5-2.0 $\mu\text{g}/\text{dl}/1,000$ ppm, when relying upon the studies that have been carefully pair-match controlled (EPA, 1986; Rabinowitz, 1988; Steele, 1990). Using a slope factor of 2.0 dictates that blood lead levels might conceivably be 1 $\mu\text{g}/\text{dl}$ greater if soils were remediated to 1,000 ppm rather than 500 ppm, and no additional educational or institutional measures were taken. Given that background lead levels are in the 5-6 $\mu\text{g}/\text{dl}$ range and are declining (Bornschein, 1990; EPA, 1989b), it is apparent that the possible 1 $\mu\text{g}/\text{dl}$ difference in blood lead would not elevate the population mean or upper 95% confidence limit blood lead levels into an unacceptable range. In fact, the Society for Environmental Geochemistry and Health (SEGH) Soil Lead Task Force final report (1990) indicates that use of a 2.0 $\mu\text{g}/\text{dl}/1,000$ ppm slope factor results in an acceptable soil lead level of 1,400 ppm. At this soil level, 99% of the children were calculated to have a blood lead level below 15 $\mu\text{g}/\text{dl}$.

Thus, it is likely that the interim guidance is highly conservative in choosing a 500-1,000 ppm soil lead range, and that the higher end of this range would be protective in most cases.

2.1.3 Intercorrelations Between Soil Lead, House Dust Lead and Blood Lead May Obscure the True Relationship Between Soil Lead and Blood Lead

The previous sections have shown that soil lead appears to have only a weak effect on blood lead. This is based upon studies indicating a likely soil lead/blood lead slope of 1.5-2.0 $\mu\text{g}/\text{dl}$ per 1,000 ppm. However, even this slope estimate may be too high because of the difficulty in separating the influence of house dust lead vs. soil lead on blood lead. Multivariate analyses endeavor to segregate the effects of different environmental sources

of lead, but this is problematic when several sources (e.g., soil lead and house dust lead) are correlated to each other.

The Ontario Lead in Soil Committee (1987; Document 105) recognizes this problem stating that "where many variables intersect, regression analyses may be limited in their ability to differentiate the relative contribution of each significant variable, or the affect of removal of a single variable". The Committee report was concerned with misleading conclusions that could be gleaned from regression analyses between soil lead, house dust lead and blood lead, since soil lead is correlated to house dust lead and house dust lead is a major contributor to blood lead. They conclude that in spite of the slope factors found in regression analyses, "if soil lead is removed, but house dust and air lead levels remain constant, then blood lead levels may not drop significantly".

The overriding importance of house dust lead in determining blood lead has been demonstrated in several studies (Charney, 1980; Charney, 1983; Baker, 1977; Vimpani, 1985), and was also clear from the Ontario experience. The Ontario Lead in Soil Committee concluded that remediation of house dust lead is more important than remediation of soil lead because of the following evidence: 1) blood lead levels in South Riverdale children were elevated, in spite of the fact that South Riverdale soils are grass-covered, making the soil not readily available to children as dust; 2) decontamination of homes to remove dust lead significantly decreases blood lead levels, while the removal of lead contaminated soil in South Riverdale apparently did not; and, 3) no significant correlation could be found between an individual child's blood lead level and the corresponding soil lead level. This evidence led the Committee to conclude that "although soil lead levels may be predictive of blood lead levels in a particular community, this cannot be extrapolated to

mean that removal of soil lead will necessarily result in a significant reduction in blood lead levels".

House dust lead makes a greater contribution to blood lead than does soil lead, primarily because of the greater time spent indoors by young children (Duggan, 1983). Only 20-30% of the total amount of the lead ingested by children occurs out-of-doors (EPA, 1989b), making exposure to indoor dust of primary importance. This difference is amplified due to the consistently greater concentrations of lead found in household dust relative to soil (TRC, 1990). These factors indicate that the correlations between blood lead and soil lead found in various studies may be the result of dust lead effects on blood lead, with only a small effect due to soil lead. There has not been any clear evidence that soil lead can elevate blood lead, only suggestive correlations between the two parameters. However, dust lead is clearly responsible for elevations in blood lead, as shown by the beneficial effect of dust lead remediation on blood lead (Charney, 1983; OSLC, 1987; Milar, 1982). Additionally, several studies indicate that in cases where house dust but not soil lead levels are elevated, there is a substantial impact on children's blood lead (Baker, 1977; Milar, 1982; Duggan, 1983). The apparent lack of beneficial effect of soil lead remediation on blood lead weighs against an important effect of soil on blood lead (OLSC, 1987). The clear trend in which decreases in ambient lead correlate well with decreases in blood lead (Annest, 1983) signifies that soil lead is not a major influence on blood lead. Lead in soil is very stable and would not decrease in parallel to declines in ambient lead. Therefore, other environmental factors, such as house dust lead resulting from indoor ambient deposition are likely to be much more important in determining blood lead.

2.1.4 Soil Lead is Not the Major Source of House Dust Lead

Due to the statistical link between soil lead and house dust lead, and since house dust lead is clearly and causally linked to blood lead, it is very likely that much of the influence attributed to soil lead is a consequence of the association between house dust lead and soil lead. Of course, the possible contribution of soil lead to house dust lead must be considered in order to understand the ultimate source of lead in blood. The correlation between soil lead and dust lead suggests that soil lead might be an important contributor to dust lead. However, the most important sources of dust lead appear to be unrelated to soil lead. Lead-containing interior house paint and the indoor fallout of ambient lead seem to outweigh soil lead. The OAQPS validation efforts for the U/B Model, using data from lead smelter sites, indicate that house dust lead is approximately twice as dependent upon ambient lead as compared to soil lead (EPA, 1989b, Appendix B). The most recent version of the U/B Model (Cohen, 1990) utilizes a soil contribution to house dust factor of 27%, i.e., EPA is assuming that 27% of house dust lead is derived from soil lead. Since this default value ignores leaded paint contributions to house dust lead, it is clear that soil lead is, in many cases, only a small percentage contributor to house dust. For example, in studies of lead in house dust (Clark, 1985), housing stocks unlikely to contain lead paint had a baseline dust lead level of 350 ppm. However, in older homes, dust lead levels averaged 1,410 ppm, and were approximately two-fold higher if the home's condition was dilapidated. Similar results have been obtained in other studies, indicating that indoor lead paint is the most important source of house dust in older homes (Farfel, 1985; EPA, 1986; Laxen, 1987; Davies, 1990). Lead paint can be expected to elevate dust lead from a baseline level of 300 ppm to 2,000 ppm (EPA, 1986), and childhood blood lead levels were 2-4 times higher in homes likely to contain lead paint (Clark,

1985). Steele, et al. (1990) studied the relationship between house dust and garden soil lead in two British communities impacted by mining. They found a low transfer coefficient for the movement of soil lead indoors, and concluded that a soil lead level of 3,900 ppm would be required to contribute enough lead to the indoor environment to equal that derived from indoor sources.

The role of indoor deposition of ambient lead in elevating house dust lead levels was shown in a study by Sayre and Katzel (1979). An examination of 24 homes in upstate New York which had been vacant for extended periods of time indicated that dust lead was highest on windowsills and on surfaces closest to windows. This gradient of dust lead concentration, combined with the evidence that better-secured windows were associated with lower dust lead levels, strongly suggested that ambient lead particles entered the houses through spaces and gaps around the window. House dust lead levels near windows were very high in certain cases, with levels of over 7,000 ppm found. Although lead paint was not completely ruled out as a source of the dust lead, the evidence that the windowsills with the highest dust lead were not painted strongly supports the concept that ambient deposition was responsible for creating high indoor dust lead levels.

The importance of indoor deposition of ambient lead and/or indoor sources of lead (e.g., lead paint) is supported by the data TRC provided as part of the PRP Committee's good faith offer (TRC, 1990). Comparison of house dust to soil lead levels at 13 lead smelter sites demonstrated that, at soil lead levels of 2,000 ppm and below, house dust levels were approximately two-fold greater than levels in soil. If soil lead was a major contributor to dust lead, then soil lead levels should be similar to or greater than dust lead levels. The available data suggests that this may begin to be the case if soil lead levels are excessive (>2,000 ppm), while at lower soil lead levels, indoor sources and ambient deposition appear to be more important.

Since soil lead does not appear to be a major component of dust lead, then the correlation between soil lead and dust lead is most likely due to the simultaneous deposition of ambient lead to indoor and outdoor surfaces and due to the presence of lead paint both on the interior and exterior of many homes.

2.1.5 Lead Uptake/Biokinetic Model Approaches for Granite City

In Appendix B of the ROD, Region V used the Lead Uptake/Biokinetic (U/B) Model to demonstrate that the 500 ppm clean-up standard would be protective while a 1,000 ppm standard would be insufficient. According to the ROD, the U/B Model is EPA's "favored" mechanism to make predictions regarding blood lead and to "yield estimates of the relative contributions of air, dietary, and soil lead to the total estimated lead uptake" (ROD, App. B). The U/B Model was used extensively to help set soil remediation guidelines at a similar former smelter site, Superfund site (Bunker Hill) by EPA, Region X (EPA, 1990). This October 18, 1990 risk assessment clearly stated that "The model (U/B Model) will be used for determination of remedial goals for the protection of public health and for the evaluation of remedial alternatives" (see below for U/B Model - Bunker Hill discussion). Therefore, the U/B Model had a prominent role in the setting of soil remediation standards at Bunker Hill and, according to the ROD, Region V also relied upon this model in its decision for Granite City.

TRC reviewed EPA's use of the U/B Model for Granite City and found that Region V had used outmoded and unrealistic assumptions regarding dietary lead exposure, which greatly inflated the predictions of blood lead. Further, TRC utilized the U/B Model, incorporating current dietary lead exposure values and adjusted (based upon model validations) lead absorption values [which are consistent with EPA guidance (EPA, 1989b)], to derive the most realistic predictions possible of blood lead levels in Granite City children.

TRC's analysis (TRC, 1990) was provided to EPA and is on the public record. In summary, this analysis indicated that a soil lead level of 1,000 ppm would result in a mean blood lead level of 6.47 $\mu\text{g/dl}$ (45% below Region V's prediction) with only 1.65% of the children predicted to have a blood lead greater than 15 $\mu\text{g/dl}$. Region V stipulated a safety threshold in the ROD that no more than 5% of the children should have blood lead levels greater than 15 $\mu\text{g/dl}$. Further, TRC's analysis indicated that remediation of soil lead to 500 ppm instead of 1,000 ppm would provide an additional decrease in blood lead of only 0.36 to 1.26 $\mu\text{g/dl}$, depending upon assumptions made regarding how house dust lead would change in response to the soil lead change. This blood lead response to changes in soil lead is consistent with the slopes obtained from the pair-matched studies discussed above.

These analyses indicated that Region V's use of the U/B Model to support the 500 ppm remediation standard was inappropriate, and that the proper use of the Model demonstrates that 1,000 ppm would be protective, with little additional benefit from a further reduction to a soil lead of 500 ppm.

The Bunker Hill risk assessment (EPA, 1990) performed a similar U/B Model validation and remedial alternative analysis as that performed by TRC for Granite City (TRC, 1990). However, an important difference is that for Bunker Hill, considerably more blood lead and house dust lead data is available with which to validate the model. Therefore, U/B Model parameter adjustments for Bunker Hill are more site-specific than those derived by TRC for Granite City. Nevertheless, the key parameters governing lead uptake from soil/dust, gastrointestinal absorption and soil ingestion were set to similar values to those used by TRC for Granite City. In fact, the Bunker Hill U/B Model validations demonstrated that TRC may have slightly overestimated soil/dust lead uptake. TRC assumed that children would ingest, on average, 100 mg soil per day, and from model validations, TRC derived a g.i. absorption coefficient

of 19% for exposure to soils of 1,000 ppm or greater. The soil/dust lead dose coefficient (product of soil ingestion and g.i. absorption), which indicates the degree of lead exposure to and uptake from soil/dust lead, was 19 mg/day, as derived by TRC. However, this value for Bunker Hill was 15-18 mg/day, based upon a similar g.i. absorption rate (20%), but lower amounts of soil ingestion.

These comparisons between two former smelter sites indicate that TRC's predictions of children's blood lead in Granite City are likely to be realistic and somewhat conservative. However, this needs to be verified by a complete blood lead/environmental lead study, in which the U/B Model could be validated for Granite City. Then the U/B Model could be used, as it was for Bunker Hill (EPA, 1990), to establish soil remediation standards which are protective for young children.

In responding to the PRP "good faith" offer, which included TRC's U/B Model analysis, Region V backed away from the modeling approach as a basis for the remediation standard. Without using this tool, and by previously discarding the possibility of using the RfD and slope factor approaches, Region V has removed all possible quantitative methods for the evaluation and setting of a soil remediation standard.

The remediation concentration is a numerical value that requires data input and some form of data interpretation/application to derive a specific number. Since Region V has removed the available methods for data analysis and quantitative standard setting from this process, the remainder of their justification for the 500 ppm standard is based upon vague assertion without any connection being drawn between the factors discussed and their quantitative impact on blood lead. This, then, is a highly qualitative, subjective approach which evades the crucial question of whether childhood exposures to soil lead at 1,000 ppm would cause adverse health effects, and if

so, would these be any greater than that caused by 500 ppm. The remainder of Region V's defense of the soil lead remediation decision is reviewed in the following sections.

2.2 Reliance Upon the EPA (OSWER) Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites

This Office of Solid Waste and Emergency Response (OSWER) interim guidance document (1989; Document 69) is discussed in detail in Section 3.5. The guidance sets the allowable soil lead level generally at 500-1,000 ppm in residential areas, with the exact standard depending upon site-specific conditions. Values outside the range also may be appropriate. As mentioned in Section 3.5, this recommendation is based upon an undocumented Center for Disease Control (CDC) assertion that "lead in soil and dust appears to be responsible for blood levels in children increasing above background levels when the concentration in the soil or dust exceeds 500 to 1,000 ppm" (see Section 3.17). While the CDC document does not offer references to support this claim, an ATSDR document (Document 85, Section 3.8) provides 2 references to support the same statement. Section 3 of this report points out that the 2 references cited (Baker, 1977 and Mielke, 1984), in fact, do not support the conclusion as it relates to soil lead in the 500-1,000 ppm range. The Baker study applies only to house dust lead, and the Mielke study is extremely weak and incomplete, and suggests that the hazards associated with lead in house paint were the major factor responsible for the blood lead elevations found.

The OSWER interim guidance emphasizes the importance of site-specific factors in dictating the remediation standard. An overriding site-specific factor in the case of Granite City is that 3 previous blood lead studies (1976, 1979, 1982) have not indicated that the blood lead levels of Granite City children significantly differed from that of other areas (IEPA, 1983).

These data, gathered when the smelter was in operation, suggest that soil lead is a minor contributor to blood lead in Granite City, possibly because of low contact with the soil, low absorbability of the lead in soil, or due to educational/demographic/behavioral factors. Since the smelter has ceased operation and other environmental lead sources have been removed, current study would probably show significantly lower levels. Further, previous studies at Granite City have not measured the most important factor in creating blood lead in young children, house dust lead. It is possible that house dust lead levels are low in Granite City, especially in recent years since the smelter ceased operations in 1983. This eliminates a major, direct source of house dust lead (ambient deposition indoors) (Sayre, 1974). These site-specific factors can only be analyzed by a detailed blood lead and environmental lead analysis, which the PRP committee offered to conduct as part of the "good faith" offer. However, Region V has rejected this option and thus has refused to consider the site-specific information needed to make a proper decision.

It is noteworthy that the Ontario Lead in Soil Committee decided that a general remediation standard of 500-1,000 ppm is appropriate. However, for the particular area of concern, where blood lead levels were significantly elevated above background levels, a standard of 500 ppm was set. Other areas not demonstrating evidence of blood lead elevations were not required to comply with this standard.

2.3 Lead Bioavailability

Region V uses the evidence that lead smelter emissions have high bioavailability as a site-specific factor dictating the use of a 500 ppm rather than a 1,000 ppm remediation standard. A bioavailability of 30% for children who ingest lead in soil is considered adequate to represent the

uptake of lead from soil (EPA, 1989b; Cohen, 1990), and this value has been incorporated into the U/B Model. However, it has been demonstrated that using this level of soil lead absorption, the U/B Model over-predicts blood lead levels around a smelter, in cases of high soil lead levels (EPA, 1989b). TRC, guided by EPA's validation efforts with the U/B Model, derived absorption values (which vary as a function of soil lead concentrations) that best fit actual blood lead data and used these values (19-27% absorption) in the U/B Model runs for Granite City (TRC, 1990). These model runs indicated that soil lead absorbability plays an important role in determining the impact of soil lead on blood lead, and that with realistically high soil lead absorption factors incorporated into the U/B Model, a 1,000 ppm soil lead level would not be expected to produce a major impact on blood lead levels in children.

Based upon the recent Bunker Hill risk assessment (see Section 2.1.5), TRC's estimate of soil/dust lead exposure may have been too high, with either lower g.i. absorption or soil ingestion rates more appropriate. However, the availability of lead in Granite City soils should not be assumed, but should be investigated via a blood lead/environmental lead study. This is especially so since previously conducted studies suggest that soil lead in Granite City is either unavailable or not well absorbed.

It is important to note that in other published studies in which soil lead bioavailability should have been high, as a result of smelter lead or automobile exhaust deposition, the impact of soil lead on blood lead has been low, with slope factors in the range of 0.6 to 2.2 $\mu\text{g}/\text{dl}$ per 1,000 ppm soil lead increase (see Section 2.1.2). Therefore, the theoretically high bioavailability of soil lead does not necessitate that soil lead will be a major influence on blood lead.

2.4 Protection of Special, At-Risk Children

In support of the 500 ppm remediation standard, Appendix B of the ROD states that "children who show tendencies toward frequent mouthing activities can ingest large amounts of soil and indoor dust and hence, large amounts of lead. Those who are nutritionally compromised and/or exhibit pica might be at risk for severe health effects".

This factor is of no consequence when establishing a soil lead remediation level because these specially susceptible children are accounted for in the setting of acceptable and protective blood lead levels. A population blood lead mean value was targeted in the ROD such that no more than 5% of the Granite City children would experience blood lead values greater than 15 $\mu\text{g}/\text{dl}$. This safety cutoff (5% above 15 $\mu\text{g}/\text{dl}$) is derived from the variability inherent in the population of children whose blood lead levels will be screened (EPA, 1989b). This value is termed the geometric standard deviation (GSD) of the population geometric mean blood lead level. Nutritional and behavioral (e.g., mouthing activity, pica) differences between children will increase the variability in the population's response to lead in soil, causing an increase in the GSD. An increase in the GSD would, in turn, cause a reduction in the acceptable mean blood lead level to accommodate the more at risk children, with the aim that only 5% remain above 15 $\mu\text{g}/\text{dl}$.

Population GSD values for blood lead levels in children residing near smelters ranges between 1.29-1.57 and the national GSD for children in general is 1.42 (EPA, 1989). These GSD values are an expression of the variability in the sampled children in terms of nutritional deficiencies, mouthing activity, etc. which would impact lead exposure and absorption. The EPA uses a GSD value of 1.42 to model and study children residing near smelters (EPA, 1989). TRC's use of the U/B Model incorporated this GSD value and found that only 1.65% of the children in Granite City could be expected to experience blood

lead levels above 15 µg/dl at a soil lead level of 1,000 ppm. The SEGH Task Force, using an alternative approach and a GSD of 1.40, also showed that 1,000 ppm would be a protective soil remediation level. Thus, only a very small percentage of the population might be classified at special risk due to unusually high exposure to, or absorption of lead.

It is important to reiterate that since the variability inherent in the population's response to soil lead is accounted for in the blood lead safety threshold, it is superfluous to discuss such risk factors in terms of soil remediation standard setting. The only reason to raise these risk factors would be if it were demonstrated that Granite City children exhibit a greater degree of these risk factors than is typically seen. This type of site-specific information would be crucial to a lead in soil standard. The fact that the previous blood lead studies conducted at Granite City failed to find blood lead elevations, in spite of elevations in soil and ambient lead, suggests that the children of Granite City do not exhibit a high propensity for behaviors that increase the risks to soil lead.

2.5 The Residential Nature of Granite City

Region V cites the residential nature of Granite City as rationale for setting a 500 ppm soil remediation standard. However, the OSWER interim guidance (Section 3.5) used by EPA, as well as the Ontario Lead in Soil Committee report (Section 3.11) clearly state that the 500-1,000 ppm range is acceptable for residential areas, with higher levels allowable for non-residential areas. Therefore, these guidances provide a range of allowable soil lead levels for areas containing residences and children; they do not say that the presence of residences should force the remediation standard to the lower end of the range. The Ontario report states that the

site-specific determinants have to do with socio-economic and technical factors.

There is no indication from any of the guidances or documents in the Administrative Record that the number of residences or population density in the impacted area is a site-specific factor in setting the remediation standard. Therefore, the residential nature of Granite City should not be a driving force in setting the standard at a particular soil lead value. The specific level set should obviously depend upon factors other than the presence of homes in impacted areas. Therefore, this justification is irrelevant to the 500 ppm decision, although it does narrow the range, according to the interim guidance, for standard setting to between 500 and 1,000 ppm lead in soil.

It is important to note, as stated above and discussed under Section 3.12, that the interim guidance is not supported by experimental evidence, and that a shallow slope between soil lead and blood lead is likely. This implies that the 500-1,000 ppm soil lead range chosen in the interim guidance is conservative, and that the upper end of this range would be suitable in most cases (TRC, 1990; SEGH, 1990).

2.6 Synergistic Action by Other Industrial Pollutants

Region V states that since Granite City is highly industrialized, residents are likely to be exposed to a complex mixture of toxic substances, which may act to increase the toxic effects of lead in a synergistic manner. This concern is used to bolster the case for a 500 ppm soil lead remediation level.

This factor is highly speculative and completely unsubstantiated. The Administrative Record, as well as the scientific literature that we are aware of, contains no evidence for a synergistic potential between lead and other

industrial pollutants. The adverse health effects and specific agents of concern were not defined by Region V. They did, however, cite a Federal Register notice (FR 50, 1985) indicating that complex mixture risk assessment is a growing concern. This FR notice contains no detail regarding specific chemicals of concern, but merely lays out broad guidelines for complex mixture risk assessment. The notice does indicate the need for consideration of biochemical mechanisms, target organs, and chemical composition of the mixture before making judgments regarding synergism, additivity, or antagonism of effects. Clearly, Region V did not consider these factors when postulating that the industrial pollutants present in Granite City may synergize lead's effects.

Antagonistic effects (e.g., impairment of or competition for absorption) between industrial pollutants and lead are not inconceivable. Lead's bioavailability is impaired by simultaneous ingestion of zinc (Cerklewski, 1976), and elevated zinc levels can be found in the vicinity of smelters (Bornschein, 1990). Therefore, this assumption put forth by Region V in support of the 500 ppm standard is baseless.

3.0 REVIEW OF THE ADMINISTRATIVE RECORD FOR THE GRANITE CITY ROD

This section examines the documents listed in the Administrative Record which might have had some impact on the setting of the soil remediation standard because of evidence concerning the relationship between soil lead and blood lead. However, except as previously noted, Region V did not explain how or if their documents substantiated their decision. The Administrative Record documents not reviewed in this report were judged to be irrelevant to this issue, based upon the way in which they were listed in the Administrative Record Index.

3.1 Document 45:

Letter from O'Brien & Gere to Region V in response to an August 3-4 meeting with Region V regarding the risk assessment in the RI report.

There is no information in this document which is pertinent to the issue of the soil lead remediation level which cannot be found in the RI final report.

3.2 Document 46:

Letter from O'Brien & Gere to Region V in response to an August 3-4 meeting with Region V.

This letter presents O'Brien & Gere's position regarding analytical results from ground water monitoring. This document is not pertinent to the issue of the soil lead remediation level.

3.3 Document 66:

Transmittal to NL Industries of IDPH soil sampling results and lead environmental and human effects papers. The papers transmitted to NL are listed below:

- a. Koeppe, D.E., 1977. The Uptake, Distribution and Effect of Cadmium and Lead in Plants.

- b. Rodriguez-Flores, M., 1982. Lead and Cadmium Levels in Soil and Plants Near Highways and Their Correlation with Traffic Density.
- c. Chaney, R.L., 1982. Potential Effects of Waste Constituents on the Food-Chain.
- d. Logan, T.J., 1983. Utilization of Municipal Wastewater and Sludges on Land - Metals.
- e. Stoewsand, G.S., 1978. Report on the NYC-UGP Cabbage Feeding Studies - 1977-78.
- f. Shibko, S.I., Undated. Sources and Levels of Lead and Cadmium in the Diet.
- g. Lowenberg, R., Undated. Dietary Intakes of Lead and Cadmium in Vegetables Grown in New York City.
- h. Kneip, T.J., Undated. Concentrations of Lead and Cadmium in Garden Vegetables Grown in New York City.

Neither the IDPH soil sampling results nor the above articles sent to NL are pertinent to the issue of the soil remediation level for Granite City. These articles deal with plant uptake of lead in soils and the possibility for human ingestion of lead in the food chain. The information presented does not indicate the soil lead levels required for human food chain exposure. Further, these exposure routes are not of particular relevance for Granite City (IEPA, 1983).

3.4 Document 68:

ATSDR Report titled "Preliminary Health Assessment for NL Industries/Taracorp Lead Site" dated January 18, 1989.

ATSDR prepared a preliminary health assessment for the Granite City site, apparently relying upon data provided in the RI/FS, although this was not stated. The report reviewed the types of contamination found on-site and potential pathways of human exposure. With regards to the soil lead issue, the report simply states that "Elevated levels of lead were found in soil," and reiterated the statement in the OSWER interim guidance (Document 69, see

Section 3.5) that soil lead above 500-1000 ppm appears to be responsible for elevations in children's blood lead levels.

The basis for this statement has not been thoroughly described or well-supported by the cited literature (Section 3.5). It is important to note that blood lead levels in children may increase incrementally as soil lead increases between 500 and 1000 ppm, but based upon the best estimates of the soil lead/blood lead slope, this elevation would be very minor and difficult to detect (see Section 2.1.2). Further, due to the overriding importance of house dust lead, it is very difficult to weigh the effect of soil lead, other than to say that it is slight, certainly considerably less than that due to house dust (see Section 2.1.3).

The ATSDR report states that soil lead concentrations in residential areas near the site showed concentrations up to three times higher than the 500-1000 ppm range. The final recommendations of this preliminary report regarding the lead in soil issue were as follows:

"The contamination of residential soil in the vicinity of the NL Industries Site should be accurately evaluated. Such an evaluation should allow for an adequate determination of the levels of exposure of individuals per residence. If residents, specifically children, are indeed exposed to levels of contaminants, namely lead, which may result in adverse health effects, actions should immediately be taken to prevent further exposure."

Thus ATSDR apparently did not find reason for immediate action, at least not without additional data gathering. Further, ATSDR did not stipulate what soil remediation level should be used, only that action should be taken in cases where children are exposed to levels of lead in soil that could produce adverse health effects. This recommendation, calling for additional data gathering, is supportive of the PRP group's offer to conduct an extensive environmental/blood lead study in order to form the basis for a site-specific soil lead remediation decision. ATSDR leaves open the question of the impact

of soil lead on blood lead, and so other evidence, as documented in Sections 2.1.1-2.1.3 needs to be utilized.

3.5 Document 69:

Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites: Henry Longest, 9/7/89, OSWER Directive #9355.4-02.

This document is the primary basis for Region V's establishment of the soil remediation level for Granite City. It sets the interim soil cleanup level for total lead at 500-1,000 ppm, which the Office of Emergency and Remedial Response and the Office of Waste Programs Enforcement "consider protective for direct contact at residential settings". It states that "site-specific conditions may warrant the use of soil cleanup levels below the 500 ppm level or somewhat above the 1,000 ppm level". The document does not stipulate what types of site-specific conditions need to be considered, or how these factors should be used. However, it is clear that this interim guidance allows residential soils to approach or exceed 1,000 ppm, depending upon site-specific factors.

The interim guidance is flawed because it derives an acceptable value for soil lead without relying upon quantitative evidence regarding soil lead effects on blood lead. The guidance claims that the remediation level is derived from a "recommendation in the 1985 CDC statement on childhood lead poisoning.... which states that lead in soil and dust appears to be responsible for blood levels in children increasing above background levels when the concentration in soil or dust exceeds 500 to 1,000 ppm". However, the CDC document cited, "Preventing Lead Poisoning in Young Children (CDC, 1985; Document 112), doesn't actually recommend a soil remediation level. Instead, it merely presents the statement quoted in the interim guidance and repeated above. This key statement was without documentation and appears to

rely upon the CDC reviewer's general feel for the field (Smith, 1990). However, the 1988 ATSDR document, "The Nature and Extent of Lead Poisoning in Children in the United States: A Report To Congress" (Document 85), reiterates the CDC statement in this quote from Page VI-30: "In general, lead in dust and soil at levels of 500 to 1,000 ppm begins to affect children's blood lead levels (Baker, 1977; Mielke, 1984)". Thus, the only studies that were used in support of the key statement in the interim guidance are those of Baker and Mielke. These studies are summarized below.

- a. Baker, et al., 1977, presents data on the relationship between house dust lead and blood lead in children without any reference to soil lead. Lead was introduced into these homes due to the contamination of workers' clothing by lead from the operation of a secondary smelter. The data shows a dramatic rise in children's blood lead at house dust lead levels of >1,000 ppm (N=5 children). The data were not subdivided below 1,000 ppm which disallows any conclusion regarding whether dust levels in the 500-1,000 ppm range influence blood lead. Therefore, this study does not support the contention made in the ATSDR, CDC and interim guidance documents. Further, since this study focused on house dust lead and, as mentioned in Section 2, house dust lead has a stronger effect on blood lead than does soil lead, the correlation found in this study cannot be applied to soil lead.
- b. Mielke, et al., 1984, presents data on the relationship between a surrogate indicator of lead exposure, free erythrocyte protoporphyrin (FEP), and soil lead in urban Minnesota children. Region V, in the Granite City ROD, criticized FEP values in terms of their usefulness as a quantitative indicator of lead exposure (EPA, 1989). This study is not useful to evaluate the relationship between blood lead and soil lead because of the lack of blood lead data. However, even using FEP as a surrogate for blood lead levels, the study results show a better association between lead absorption and lead paint than between lead absorption and soil lead. When the children were divided into lead poisoning cases and children with low FEP levels, it was found that, while a higher percentage of cases was found in the 500-999 ppm soil lead group (52% of cases vs. 36% of low FEP children), equal percentages were found in the >1,000 ppm soil lead group (33% of cases vs. 36% of low FEP children). These data are not sufficient to establish a link between soil lead and elevations in FEP, especially in light of the correlation between lead poisoning and lead paint in this study (cases - 76% with lead paint in homes vs. low FEP children - 43% with lead paint).

In summary, the interim guidance establishing an acceptable residential soil lead level of 500-1,000 ppm was not based upon experimental evidence that soil lead in this range makes a measurable contribution to blood lead. Since the ROD for Granite City relies predominantly upon the interim guidance, it is clear that a scientific basis for the 500 ppm remediation standard has not been properly established.

3.6 Document 70:

ILZRO Environmental Report: Article titled "Task Force Meets and Prepares Draft Document on Lead in Soil Guidelines".

The newsletter article presents a summary of the SEGH Task Force on Lead in Soil Draft Document. The approach developed by the Task Force was a soil lead matrix model which establishes soil lead remediation levels based upon the target blood lead and the soil lead/blood lead slope. They found that if blood lead increases by 2 $\mu\text{g}/\text{dl}$ per 1,000 ppm increase in soil lead, then a soil lead level of 1,500 ppm is adequate to insure that 99% of the blood lead levels in children would be below 15 $\mu\text{g}/\text{dl}$. This model takes into account blood lead levels due to background sources. If higher slope factors are used, then the soil remediation level would be accordingly lower. The Task Force points out that this determination is highly site specific.

This approach provides support for the approach used by TRC in assessing the soil lead remediation level based upon model predictions (U/B Model) for Granite City. Region V rejected this approach in its September 14, 1990 letter. This is counter to other EPA opinions on the usability of the soil lead/blood lead relationship in setting remediation levels. The Director of EPA's Health and Environmental Assessment Office (Dr. William Farland) and other EPA representatives (Robert Elias, Chris DeRosen, and Harold Choudbury) were involved with and supported the SEGH Task force efforts and conclusions

(see ILZRO Article). Therefore, Region V's rejection of the evaluation of and establishment of a soil remediation level, as conducted by TRC, is inconsistent with other EPA-supported guidance and leaves no quantitative basis for the derivation of a remediation standard.

3.7 Document 84:

Minnesota Department of Health Report to the Minnesota Legislature:
Lead Exposure and the Health Effects on Children, February, 1984.

This document addresses the soil lead/blood lead relationship on Page 27. It cites a study by Yaffee (1983) which interprets matched soil lead and blood lead data to indicate that "a lead concentration of 1,000-2,000 ppm in dust and soil seems to result in unacceptable, though not dramatic, elevations in blood lead concentration". A selected review of the pre-1983 literature indicated that the relationship between soil lead and blood lead is highly variable, with values ranging from 1 to 10 µg/dl change in blood lead per 1,000 ppm change in soil lead. The Minnesota report states the importance of house dust lead in contributing to children's blood lead (pg. 59), with levels >1,000 ppm in house dust considered to be a definite concern.

This report makes no recommendations regarding a lead in soil remediation goal; the review provided in the report makes the implication that there may be a threshold of lead in soil/dust which must be reached before there is an increase in lead body burden.

3.8 Document 85:

ATSDR Document titled "The Nature and Extent of Lead Poisoning In Children In the United States: A Report to Congress," dated 7/88.

This document focuses upon the factors which contribute to excessive lead exposure and develops estimates of the number of children living in the U.S. who might be at risk due to exposure to high levels of lead.

The following are the only references found in the report made to the soil lead/blood lead issue.

Page I-20: In discussing the potential for children to be exposed to lead in dust and soil, ATSDR states that "Actual exposures of children to soil/dust lead sufficient to raise Pb-B levels to the range of toxicity risk cannot be estimated at this time, but the actual numbers may be considerable." Thus, ATSDR appears to recognize the uncertainties inherent in attempting to attribute a quantitative role for soil lead in affecting blood lead.

Page I-44: Mention is made that dust and soil are major sources of lead exposure because of the rather high levels of lead in these media, their ubiquitous distribution, and young children's propensity for exposure to this source. This statement does not provide quantitative evidence for the importance of soil vs. house dust or other environment sources, and so cannot be used to imply that soil lead is more important than other sources such as paint or house dust.

Page VI-30: The fact that a relationship exists between soil lead and blood lead is mentioned, and the assertion made that "In general, lead in dust and soil at levels of 500 to 1000 ppm begins to affect children's Pb-B levels (Baker, et al., 1977; Mielke, et al., 1984)." This statement and the supporting references were critiqued in Section 3.5, where it was demonstrated that this statement is not supported by experimental evidence. However, it is possible that some small, incremental rise in blood lead occurs as soil lead increases between 500-1000 ppm. The exact size of this increment is expected to differ in site-specific and child-specific ways, but should be very small based upon the best estimates of blood lead/soil lead slopes generated from carefully controlled, pair-matched studies (see Section 2.1.2).

Page VI-33: The assertion is made that "between 5.9-11.7 million children are potentially exposed to dust/soil lead. Estimates of children exposed to

lead in dust and soil sufficient to elevate Pb-B levels to potentially toxic ranges cannot be readily obtained in any precise way."

With this statement, ATSDR recognizes that although children may be exposed to lead in soil, this exposure is not necessarily harmful, but must be evaluated in terms of the degree of blood lead elevation. Further, ATSDR recognizes that the relationship between soil and blood lead is not readily obtained.

The ATSDR comments regarding soil lead's contribution to blood lead indicate the importance of obtaining the best, site-specific data in deriving the soil lead-to-blood lead relationship. The uncertainties raised by this report make it clear that it is inappropriate to utilize any one slope factor or soil remediation guideline in arriving at a lead in soil decision.

3.9 Document 94:

Transferral of Lead Articles from IEPA to NL Industries. The titles of the transferred articles are:

- a. Madhaven, S., et al. (1989) Lead in Soil: Recommended Maximum Permissible Levels. Environ. Res. 49:136-142.
- b. Bassuk, N.L. (1986) Reducing Lead Uptake in Plants. Hort Science 21:993-995.
- c. Spittler, T.M., et al. (1979) A Study of Soil Contamination and Plant Leaf Uptake in Boston Urban Gardens. Commun. Soil Science Plant Analysis 10:1195-1210.

Of these articles, only the first one is pertinent to the soil lead/blood lead relationship. This is discussed below.

Madhaven, et al., attempted to derive a "safe" soil lead level for incorporation into New Jersey State Department of Health guidelines. The basis for this was a selected set of studies which demonstrated a relationship between soil lead and blood lead to derive a soil lead/blood lead slope (i.e., $\mu\text{g}/\text{dl}$ blood lead increase per 1,000 ppm soil lead increase). This slope was

used to calculate the blood lead increase at candidate soil lead levels, which was then added to the background blood lead levels found in children to determine whether the composite blood lead level would be within health-based guidelines.

While the approach has some merit, the methodology and assumptions used by these authors is flawed. They relied upon a 1980 review of 21 soil lead/blood lead data sets (Duggan, 1980) to choose 8 data sets from 5 studies that appeared relevant to their task. Thus, they were working from an outdated data set (primarily pre-1977), while ignoring more recent studies pertinent to this issue (e.g., EPA, 1986). The basis for their selections was that, in the chosen 8 studies, "soil was the only source of lead, not house dust, etc., and only blood levels from children under 12 years, the most susceptible group to lead toxicity, were used to derive the slopes". The assumption that soil was the only source of lead is highly simplistic and completely negates the important contribution of house dust lead to blood lead. Three of the 5 research groups (Baltrop, 1975; Shellshear, 1973; Galke, 1975) didn't measure house dust lead at all, and so had no way of adjusting the soil lead/blood lead slope for the contribution due to house dust lead. In two cases, house dust was also measured (Angle, 1977; Yankel, 1977). The multivariate analysis of Yankel, et al. (1977), which incorporated the soil lead and dust lead data, yielded a low soil lead to blood lead slope of 0.6 to 2.5 $\mu\text{g}/\text{dl}/1,000 \text{ ppm}$ according to Madhavan, but was listed as 1.1 $\mu\text{g}/\text{dl}/1,000 \text{ ppm}$ by EPA (1986).

One of the Angle, et al. data sets used by Madhavan, which derived a completely unreasonable slope of 65 $\mu\text{g}/\text{dl}/1,000 \text{ ppm}$ was discarded both by EPA (1986) and Duggan (1980). This data set spanned a small range of soil lead levels (97 to 219 ppm) which were not statistically different from each other. These data essentially represent one soil lead data point. The authors however, assigned the spread in blood lead results (14-22 $\mu\text{g}/\text{dl}$) to

this soil lead range and derived the unreasonable slope value ($65 \mu\text{g}/\text{dl}/1,000 \text{ ppm}$). The use of this value in calculating an overall slope value applicable to New Jersey indicates that these authors used poor judgment and disregarded other analyses of the same data (Duggan, 1980; EPA, 1986). In fact, Angle, et al. (1982, 1984) employed multivariate analyses to derive an adjusted slope factor ($6.8 \mu\text{g}/\text{dl}/1,000 \text{ ppm}$) which has been used to represent this data set (EPA, 1986; Brunekreef, 1985). However, as Brunekreef (1985) points out, the Angle, et al. studies did not account for racial and socio-economic confounders which may have contributed to the urban/suburban blood lead differences found. Since substantial blood lead differences were found ($18 \mu\text{g}/\text{dl}$ vs. $24.8 \mu\text{g}/\text{dl}$) between the suburban vs. urban regions, but with only relatively small corresponding soil lead (81 vs. 339 ppm) or house dust lead differences (211 vs. 300), it appears likely that other factors relating to home cleanliness and child supervision may have played a large role. Exclusive of the Angle data set, the remaining 6 slopes range from 0.6 to $3.9 \mu\text{g}/\text{dl}/1,000 \text{ ppm}$. Therefore, it is evident that even using the adjusted Angle slope of $6.8 \mu\text{g}/\text{dl}/1,000 \text{ pm}$ (Angle, 1982, 1984), the Angle, et al. data still provide a much greater slope than the other data sets used by Madhaven. The Angle, et al. data set should not be used for the derivation of a slope factor due to the unpaired nature of the data, as discussed in Section 2.

In summary, the Madhaven use of soil lead/blood lead slopes is inappropriate because of their reliance upon outdated data, especially since they ignored the re-analyses of the Angle data set. Further, they included a completely unreasonable and invalid slope ($65 \mu\text{g}/\text{dl}/1,000 \text{ ppm}$) in their analysis, and they assumed that dust lead played no role in the increase in blood lead seen in association with increases in soil lead. Even if the severe limitations of the Angle, et al. data set are overlooked and their adjusted slope ($6.8 \mu\text{g}/\text{dl}/1,000 \text{ ppm}$) is used, then the overall slope derived

by Madhaven (8.6 µg/dl/1,000 ppm) is adjusted to 3.6 µg/dl/1,000 ppm. This slope is the 95% upper confidence limit on the mean slope and so is a worst-case representation. The mean slope value that can be derived from the studies relied upon by Madhaven is 2.0 µg/dl/1,000 ppm, which is similar to that arrived at by EPA (1986) when using a different set of studies. Thus, the Madhaven approach yielded an unreasonable slope estimate (8.6 µg/dl/1,000 ppm) which cannot be used to establish a soil remediation standard.

3.10 Document 99:

Article from E.P.A. Weekly Report entitled "Superfund Plan for Lead in Soil Cleanup Seen as Unprotective by some in EPA" from 10/27/89.

The article quotes comments by various unnamed EPA sources, regarding the 9/7/89 interim guidance on soil lead discussed above (Document 69). EPA critiques of the internal guidance were apparently not based upon the soil lead/blood lead relationship, but instead upon lead's toxic potency and upon other soil remediation decisions. Therefore, these comments do not add any evidence to the decision-making process.

3.11 Document 105:

Report to the Ontario Ministry of Environment by the Lead in Soil Committee (OLSC), Hazardous Contaminants Branch dated 5/87.

The Lead in Soil Committee, composed of government, public interest groups and lead industry representatives, was convened to advise the Minister of the Environment on an acceptable lead level in soil. This effort was spurred by the finding of high blood lead levels in children in the South Riverdale section of Toronto, which was impacted by a secondary lead smelter.

The Committee reviewed selected studies relating lead in soil to blood lead levels in children. The only studies presented in the report which provide evidence concerning the quantitative relationship between soil lead

and blood lead were those of Bornschein, et al. (1986) and Baltrop, et al. (1975). The report points out that the Bornschein data suggest that an increase in soil lead from 0-1,000 ppm would result in a blood lead increase of 6.2 $\mu\text{g}/\text{dl}$. The limitations in the Bornschein 1986 study (Document 127), are discussed in Section 3 (Document 106). However, it is important to mention in passing that the Bornschein, et al., data demonstrate strong correlations between house dust lead and blood lead, and between house dust lead and soil lead, but the relationship between soil lead and blood lead was not statistically significant. Therefore, the large effect attributed by Bornschein, et al. to soil lead is possibly due to the effect of house dust lead and not soil lead, on blood lead (see Section 2.1.3).

As pointed out in the OLSC report (1987), the Baltrop, et al. study contrasts with the Bornschein slope prediction in that Baltrop found only a 0.6 $\mu\text{g}/\text{dl}$ change in children's blood lead per 1,000 ppm increase in soil lead. With regard to this difference, the OLSC report mentioned that the area studied by Baltrop was rural with the industrial point source no longer operating, and that the Baltrop study area was largely covered with vegetation. The latter factor would decrease the availability of lead in soil, while the former factor indicates very low ambient contributions to house dust lead through ambient deposition. These factors would cause a shallow soil lead to blood lead slope. This indicates the need for a site-specific determination of the proper soil remediation standard which assesses soil lead availability and the presence of sources for ambient lead.

The OLSC report highlighted studies of South Riverdale children, which found that soil lead was positively correlated to blood lead, but that there was no correlation on an individual, child-by-child basis. The Committee took this to signify that multiple pathways and factors are involved in the determination of blood lead.

The overall report recommendations regarding the soil remediation standard stated that:

"Although soil lead levels may be predictive of blood lead levels in a particular community, this cannot be extrapolated to mean that removal of soil lead will necessarily result in a significant reduction in blood lead levels."

This statement was supported by a statement by Clark and Bornschein (1987) that "the removal of lead containing soils is unlikely to be an important intervention event in reducing blood lead". Further, the OLSC statement was based upon the lack of beneficial effect found in a prior soil remediation effort in Ontario, the lack of a correlation between soil lead and blood lead on an individual, case-by-case basis, and the fact that house dust lead is likely to be the most important source of blood lead.

The OLSC report stated that government and industry representatives "are of the opinion that available scientific evidence does not support a soil lead guideline level lower than 1,000 ppm". However, the overall recommendation for areas to which children have routine access is a remediation level of 500-1,000 ppm. The Committee reviewed the recommendations of the Royal Society of Canada that were cited by Region V in Appendix B of the ROD. The key recommendation cited stated that "in the . . . cleaning up of contamination around existing plants, . . . soil lead levels of up to 500 ppm are acceptable for residential areas". No data was supplied to support this recommendation. Further the OLSC, although aware of this recommendation, provided their own remediation guidance of 500-1,000 ppm, depending upon site-specific factors. Thus, Region V cited the recommendation from this document which was consistent with its decision in the ROD, but which did not represent the overall recommendations in the OLSC report.

In the case of South Riverdale, a soil lead standard of 500 ppm was chosen. This level was apparently not derived from the scientific evidence regarding the effect of soil lead on blood lead. Rather, since there was an existing blood lead problem in the children of South Riverdale, it was felt that all feasible measures should be taken to reduce blood lead. Further, a 500 ppm soil standard was deemed necessary to minimize the potential for lead exposure from homegrown root and leafy vegetables. However, it was recognized by the Committee that this factor would be of little significance.

The site-specific factors which governed the South Riverdale soil remediation decision do not apply to Granite City since there is no evidence, from 3 previous studies, to suggest that Granite City residents had elevated blood lead for the time periods covered by the studies (IEPA, 1983). Without this overriding factor present, the OLSC would likely not have recommended a remediation level below 1,000 ppm. Therefore, it is inappropriate to use the OLSC recommendations in support of a 500 ppm standard for Granite City. Rather, an alternative assessment is that the OLSC conclusions support a 1,000 ppm remediation standard for an area without a demonstrated blood lead problem, such as Granite City.

3.12 Document 106:

Publication by Mielke, et al., titled "Soil-Dust Lead and Childhood Lead Exposure as a Function of City Size and Community Traffic Flow: The Case for Lead Abatement in Minnesota" in the book "Lead in Soil: Issues and Guidelines", Davies and Wixson, eds., Copyright Science Reviews, Ltd., 1988, pp 253-271.

EPA Region V quotes this Mielke reference in Appendix B of the ROD as follows:

"a rapid rise in population blood lead levels takes place when the lead content of soil increases from less than 100 ppm to 500-600 ppm."

This statement appears to take a central position in EPA's defense of the 500 ppm remediation standard for Granite City. The statement was made by Mielke, et al. as part of a literature survey, and was not directly supported by the data provided by the authors in their publication. The following discussion first addresses the data provided by Mielke, et al., as it relates to the relationship between soil lead and blood lead in Minnesota. The second phase of this discussion examines the basis for the quote from Mielke, et al., used by EPA Region V in Appendix B of the ROD.

A. Mielke, et al., Data Relating Soil Lead to Blood Level

The paper utilizes a large unpaired data set of 1,266 blood lead levels taken in 1986 and 1987 in young children and an unrelated set of 1337 soil lead levels. The soil lead and blood lead data were segregated by municipality and census tract. The authors found that blood lead levels in regions with low soil lead (<150 ppm) were generally low (<10 µg/dl), while in municipalities with greater than 40% of the soils above 150 ppm, blood lead levels were somewhat elevated. The authors compared the blood lead results to age of housing within the appropriate census tracts, and concluded that the age of housing was not associated with the increases found in blood lead. Since age of housing is a surrogate index for the presence of lead paint, the authors concluded that lead paint was not a major factor in this population. Rather, they conclude that lead in soil is the major factor in causing blood lead elevations, with 150 ppm being a level of concern.

The conclusions from this study are not clearly supported by the data presented and are contrary to an important study conducted on Minnesota children which was conducted at the same time. Two sets of data were collected by state agencies: one set comprised of 187 blood lead samples matched and paired with soil lead contents from the corresponding residential

sites; the other data set was the large, unpaired set used by Mielke, et al. Mielke, et al. chose the unpaired set because the smaller matched set was biased towards children with high blood lead ($>30 \mu\text{g/dl}$). However, the matched data set, analyzed by Trippler, et al. (1988), indicated only a weak correlation between soil lead and blood lead, and their results implicate that paint lead may be the major contributor to blood lead in Minnesota children. Mielke, et al. recognize that this conclusion contrasts with their own, but they provide no explanation for the difference. However, it is obvious that paired data is a more powerful and direct indicator of a soil lead/blood lead relationship than is unpaired data. The unpaired data used by Mielke, et al. is subject to numerous inaccuracies in terms of the environmental sources of lead and thus should not be used as strong evidence for the involvement of a potential lead source (e.g., soil lead; paint lead). This is especially true in this case since an analysis of the paired data set from a similar population indicated a much less important role for soil lead (Trippler, et al., 1988).

Other problems with the Mielke, et al. analysis are that there was no accounting for, or control of socio-economic status or condition of housing, both of which could greatly affect blood lead. For example, if the higher blood lead levels found in inner Minnesota cities also corresponded with socio-economic factors (cleanliness, child supervision) that lead to greater dust/soil/paint ingestion, then the relationship found by Mielke, et al. would not be based upon differences in soil lead as much as it would be based upon demographic and behavioral factors. Leaving out these factors from the analysis can greatly skew the results and interpretation.

In summary, although Mielke, et al. use their study results to argue for the need to remediate soil lead in Minnesota, their conclusions are

unconvincing because of the presence of conflicting data from a paired data set, and because of the poor controls associated with their methodology.

B. Mielke, et al., Review of Literature Regarding Soil Lead/Blood Lead Relationship

Mielke, et al. use the studies of Angle and McIntire (1982), Bornschein, et al. (1986), Brunekreef, et al. (1981), Reeves, et al. (1982) and Vimpani (1985) to support the contention that "a rapid rise in population blood lead concentrations takes place when the lead content of soil increases from less than 100 mg/kg to 500-600 mg/kg and then the curve flattens off". The cited studies are evaluated below with respect to whether they support this key assertion of Mielke, et al.

1. Angle and McIntire (1982) Children, the Barometer of Environmental Lead Adv: Pediatrics 29:3-31

The 1982 paper is a review of these authors' previous work utilizing blood lead and environmental lead data gathered in the 1970's in Omaha, Nebraska. It provides logarithmic regression equations to relate soil lead and house dust lead separately, but not in combination to blood lead. Since their analysis of the soil lead to blood lead relationship is logarithmic ($\log PbB = 0.9766 + 0.1515 \log PbS$), then as the soil lead increases by a small amount, blood lead increases dramatically. However, this response is biphasic, i.e., at high soil lead levels (>500 ppm), blood lead levels rise only slightly by comparison. Their equation (presented above) is completely unrealistic, as it dictates that as soil lead rises from 0 to 100 ppm, blood lead increases from 9.5 to 19 $\mu\text{g/dl}$. Application of a logarithmic function to describe the soil lead/blood lead relationship skews the impact of soil lead, so that elevations in soil lead in the lower soil lead ranges is vastly more important than in the higher ranges. The correlation coefficient for this equation was

statistically significant but was only 0.38, indicating that the logarithmic equation did not fit much of the data. This analysis is also flawed in that it did not incorporate house dust lead as a contributor to blood lead, even though house dust lead data were available.

Angle, et al. re-analyzed the Omaha data in a 1984 publication, using a linear model and incorporating all measured environmental lead sources (air, soil, house dust) into one equation. This linear, multivariate analysis is a more realistic representation of the inputs to blood lead, and yielded a somewhat higher correlation coefficient (0.44). The linear relationship does not ascribe more weight to low soil lead levels, but rather assigns a slope factor of 6.8 $\mu\text{g}/\text{dl}$ per 1,000 ppm change in soil lead.

Mielke, et al. supported their key statement by citing the 1982 Angle reference while ignoring the 1984 refined treatment of the data by Angle, et al. EPA chose the 1984 treatment of the data to incorporate into the Lead Criteria Document (1986). Therefore, Mielke, et al.'s use of the Angle data is selective and biased towards finding a large effect of soil lead on blood lead at low soil lead levels.

The preceding discussion of the statistical treatment of the Omaha data does not speak to major, overriding problems in the studies conducted by Angle, et al. As mentioned briefly in Section 3.9, the Angle studies were not controlled for socio-economic and behavioral factors which can play a large role in determining blood lead. However, even more important is the lack of adequate controls put on the environmental lead analyses. The soil and house dust data were pair matched to the blood lead data in only 37 of the 1,074 blood lead samples taken. In other words, in 97% of the cases studied, there is no measure of what the actual soil lead or house dust lead levels were in the children's home environment. In these unpaired cases, the environmental lead data were from the children's school.

Use of the school data as a surrogate for the home data is unacceptable and misleading, especially for the 242 1-5 year old children studied who likely had very little exposure to lead in the vicinity of schools. The authors make a quantum leap of faith in assuming that regional school lead data would be representative of the environmental lead sources found within and around the home, and the authors provide no data or justification for this essential assumption. The small difference in soil lead and "house dust" (house dust is the wrong term since 97% of the samples were indoor school dust lead) lead levels between lead-impacted (commercial/urban) vs. non-impacted (suburban) regions is an indication that use of school lead data quenched the actual differences which could be expected. Since the regression models were forced to explain a fairly large blood lead differential (18 vs. 25 $\mu\text{g}/\text{dl}$) by small differences in environmental lead levels (soil lead: 81 vs. 339 ppm; "house dust" lead: 211 vs. 300 ppm), they naturally derived a high slope factor.

The only valid way to derive a soil lead to blood lead relationship is through analysis of a carefully matched set of data, with adequate accounting for all demographic and behavioral risk factors. The Angle, et al. (1982, 1984) analyses are severely lacking, and it is evident that the relatively high slope that they derived (Angle, 1984) is a result of the improper assigning of particular blood lead results to environmental lead data, which at best, were only of marginal relevance to the blood lead levels measured. As discussed under Section 2.1.2, better, pair-matched analyses are available, and provide a much lower soil lead to blood lead slope.

2. Bornschein, et al. (1986) Exterior Surface Dust Lead, Interior House Dust Lead and Childhood Lead Exposure in an Urban Environment. Trace Subst. Environmental Health 20:322-332

Bornschein, et al. restricted their analysis to a pair-matched data set of 81 children for which house dust, outdoor surface dust scrapings, and house

paint data were available. The data set was part of the Cincinnati Lead Study, and it was taken from an inner city population that was predominantly of low socio-economic background. The results of their analysis indicated that outside dust lead was not significantly related to blood lead, while the house dust lead/blood lead relationship was statistically significant. Further, outside dust lead and house dust lead were strongly linked. The authors assumed that the outdoor-to-indoor dust correlation signified transport of outdoor dust indoors and thus ascribed a major role for outdoor dust in elevating blood lead. However, it is likely that lead paint was largely responsible for the outdoor-to-indoor dust correlation, especially since the lead in paint levels were highly correlated to both types of dust. Utilizing the correlations between outdoor and indoor dust, and the correlation between indoor dust and blood lead, the authors derived a logarithmic expression for the dependence of blood lead on outdoor dust lead. The magnitude of this dependence is very questionable given the lack of statistical significance between outdoor dust lead and blood lead, and due to the inappropriately large weighting outdoor dust lead was attributed in defining indoor dust lead.

The relationship derived for the effect of outdoor dust lead on blood lead [$\ln (\text{PbB}) = 2.345 + .067 \ln (\text{PbSS})$, where PbSS is the measured outdoor dust levels] predicts that for an increase of outdoor dust from 0-100 ppm, blood lead would increase from 10.4 to 14.2 $\mu\text{g/dl}$. Over the range of 500-1,000 ppm, blood lead is predicted to increase by only 0.8 $\mu\text{g/dl}$ (15.8 to 16.6 $\mu\text{g/dl}$). Their fitting of the data to a logarithmic model forces large changes in blood lead at low outdoor dust levels, but only minor or insignificant changes are predicted to occur at high soil lead levels. Importantly, the authors did not validate the accuracy of their model relating outdoor dust and blood lead, i.e. they did not test the fit of the actual data to the model equation.

Therefore, it is impossible to determine whether this model adequately described the actual data. The relationship derived must be seen as an unvalidated extrapolation which, based upon the model predictions, does not appear to be realistic (see above). It is interesting to note that these authors did not attempt to fit their data to a linear model, which may have provided better correlations and more realistic relationships between blood lead and environmental lead sources.

This study must be seen as very weak support for Mielke, et al.'s contention that a rapid rise in population blood lead takes place when the lead content in soil rises from less than 100 to 500-600 ppm. This is particularly so because of the lack of statistical significance in the outdoor dust/blood lead relationship. However, even with the shortcomings of the Bornschein, et al. analysis, the overall conclusion that a very small change in blood lead is expected for increases in outdoor dust over the range of 500 to 1,000 ppm is still in line with several other studies (Bornschein, 1988; EPA, 1986). Thus, the analyses of Bornschein, et al. (1986, 1988), support the notion that remediation of soil lead from 1,000 ppm to 500 ppm would have very little impact on blood lead.

3. Reeves, et al. (1982) Analysis of Lead in Blood, Paint, Soil, and House Dust for the Assessment of Human Lead Exposure in Auckland. N.Z.J. Sci. 25:221-227

Reeves, et al. conducted pair-matched blood lead and environmental analyses in Auckland children. The children were residents of four different regions with different ages of the housing stocks. Their results indicated that as the lead content in house paint increased, childhood blood lead levels increased, as did the levels of soil and house dust lead. No regression analysis was provided, and thus it is not possible to segregate the individual contributions to blood lead elevations caused by soil lead vs. dust lead vs.

house paint lead. Further, socio-economic and behavioral factors that impact lead exposure were not accounted for.

The only support in this document for Mielke et al.'s statement that a rapid rise in blood lead occurs when the lead content of soil increases from less than 100 to 500-600 ppm is the finding that an increase in blood lead from 11.8 to 15.1 $\mu\text{g/dl}$ was seen when going from an area with an average soil lead of 24 ppm to an area containing 155 ppm. However, a further increase in soil lead from 155 to 592 ppm was not associated with an increase in blood lead, but rather a slight decline (15.1 to 14.5 $\mu\text{g/dl}$). This pattern suggests that factors not adequately controlled for (e.g., socio-economic status, child's mouthing behavior) were responsible for the increase in blood lead seen at the low end of the range of soil lead values. Further, the lack of a multivariate regression analysis of these data disallows the attribution of the increase in blood lead to any single cause.

Thus, only a small portion of the data set from Reeves et al. (1982) is consistent with the key contention made by Mielke, et al. (1988). Further, it is improper to use the data generated by Reeves, et al. to derive a soil lead/blood lead relationship without a comprehensive, combined analysis of all relevant variables.

4. Bruneekreef, et al. (1982) The Arnheim Lead Study. 1. Lead uptake by 1 to 3 year old children living in the vicinity of a secondary lead smelter in Arnheim, Netherlands. Environ. Res. 25:441-448

Bruneekreef, et al., conducted a pair-matched blood lead and environmental lead study for 95 children living within 1,000 meters of an active secondary lead smelter. Data was also collected on child's mouthing behavior, parental level of education, dustiness of homes and outdoor play time. When the correlation between 22 different variables and blood lead were independently tested, the correlations that attained statistical significance were those

between blood lead and amount of ambient lead deposition indoors, dustiness of the house, age of the child and the average number of times a dirty object was placed in the mouth. None of the parameters relating soil lead to blood lead were statistically significant. However, when the population was segregated according to the presence vs. absence of home gardens, a statistically significant relationship was found between soil lead and blood lead. That is, in the subgroup of 53 homes having a garden, the soil lead to blood lead relationship was significant.

Brunekreef, et al. then derived a regression equation for soil lead's impact on blood lead in this subgroup ($\log \text{PbB} = 2.153 + .0003 \text{ PbS}$), and found that this simple equation predicted that blood lead would increase by 6.3 $\mu\text{g/dl}$ as soil lead increases from 100 to 600 ppm. However, this equation does not account for any contribution to blood lead that might have come from house dust lead, paint lead, or behavioral factors. The authors stated in a table footnote that if only one variable is included in a regression equation, then it is the only variable out of several that contributes significantly to the explanation of the variance of blood lead. This vague statement does not clarify their methods for regression analysis, but it gives the impression that all relevant parameters were not vigorously tested in the multivariate portion of their analysis. Further, it is highly unlikely that other parameters such as indoor lead deposition and home dustiness could have not contributed to blood lead in this subgroup given the importance of these parameters in the larger data set.

The slope factor for the effect of soil lead on blood lead is quite large (14.2 $\mu\text{g/dl}$ per 1,000 ppm increase in soil lead in the range of 0-1,000 ppm), which is much greater than that derived in other studies (EPA, 1986). This problem is recognized by the authors, who provide the possible explanation that the lead uptake in Arnheim was lower than that in other studied

populations, and the slope at low lead uptake may be steeper than with high lead uptake. This explanation is unlikely since several studies demonstrating shallow slopes were in urban areas not impacted by a smelter (EPA, 1986), and thus it is likely that they did not involve as high a level of lead uptake as that in the children living within one kilometer of the Arnheim smelter.

In summary, this study provides suggestive evidence that children living in homes containing gardens may experience greater ingestion of soil lead than those in homes without gardens. However, the data and analysis provided by Brunekreef, et al., do not provide clear support for Mielke, et al.'s key statement regarding the soil lead/blood lead relationship. This is primarily because of the uncertainty surrounding the regression methods used, and because of the lack of a statistical correlation between soil lead and blood lead when the entire data set was analyzed.

5. Vimpani, et al. (1985) The Port Pirie Cohort Study: blood lead concentration and childhood development assessment. In: L. Goldwater et al., (ed.), Lead Environmental Health: The Current Issues, pp. 139-146. Duke University, Durham, N.C.

Vimpani, et al. conducted a prospective study on 600 children living in the vicinity of a lead smelter, whose blood lead levels were assayed at various times between 6 months and 4 years of age. The soil lead data was not matched to these children, but rather, a soil lead value was assigned to a particular child based upon zone of residence. House dust lead levels were not assayed, and other environmental or socio-economic/behavioral factors were not accounted for.

The results indicated that blood lead levels of children were the same in the <150 ppm soil lead zone as compared to the 150-449 ppm soil lead zone. Blood lead levels were elevated in the >500 ppm soil lead zones. However, without improved, pair-matched environmental and socio-economic/behavioral

data, it is impossible to determine what portion of the blood lead elevation was due to soil lead, house dust lead or other contributors.

This reference does not support Mielke, et al.'s key statement in that it did not show a blood lead rise in populations residing in the <150-500 ppm soil lead zones. Moreover, it cannot be used to derive a soil lead/blood lead relationship because of the unmatched design and the fact that many key variables were not included in the analysis.

3.13 Document 107:

Middaugh, J.P., et al. (1989) Health Hazard and Risk Assessment from Exposure to Heavy Metals in Ore in Skagway, Alaska. Final Report.

This report provides the results of a blood lead survey of 48 children (1-18 years of age), possibly impacted by lead-containing ore wastes. The results found no elevation in blood lead levels in this population. Environmental sampling was not pair-matched to the blood lead data, and was provided only in cursory form. The authors concluded that the low bioavailability of lead contained in ore wastes prevented an impact on blood lead levels.

3.14 Document 108:

Chaney, R.L. (2/1/90) Acidity of Stomach Secretions in Humans, Rats, and Pigs, and the Potential Importance of Stomach pH in Bioavailability of Pb in Soils and Mine Wastes.

This report evaluates the utility of various animal models in studying lead bioavailability from soil and mining wastes. This document is not relevant to the determination of a soil lead remediation standard.

3.15 Document 109:

Hoffer, B.J., et al. (1987) Toxic effects of lead in the developing nervous system: In oculo experimental models. Environmental Health Perspectives 74:169-175.

This study describes a new test system to demonstrate lead effects on nervous system development. This study is not pertinent to the soil lead/blood lead relationship or the setting of a soil lead remediation standard.

3.16 Document 110:

Abstracts from a Medline Search, Apparently conducted by EPA, Superfund Branch, 2/20/90.

This record contains abstracts for two articles (Bellinger, 1986; Rabinowitz, 1985) which are relevant to the soil lead/blood lead relationship. These articles are reviewed below.

A. Rabinowitz, M., et al. (1985) Environmental correlates of infant blood lead levels in Boston. Environmental Res. 38:96-107.

Rabinowitz, et al. conducted a longitudinal study on blood lead levels in 249 newborn babies, who were followed for two years. A host of environmental parameters indicating potential sources of lead exposure (e.g., soil, house dust, paint) were measured in the immediate environment of each child. Socio-economic/behavioral data were also recorded, and were analyzed in a subsequent study (Bellinger, 1986; see below), but not in this study.

Their results demonstrated that for 2 year old children, statistically significant correlations between house dust (floor) lead and blood lead ($r = 0.43$), between soil lead and blood lead ($r = 0.30$) and between soil lead and house dust lead ($r = 0.43$). In a multivariate regression model of environmental factors which affect blood lead, a slope factor was obtained for the effect of soil lead ($2.4 \mu\text{g}/\text{dl}/1,000 \text{ ppm}$).

The slope factor relating soil lead to blood lead may be an overestimate because of the difficulties involved in distinguishing between contributions

due to house dust vs. soil lead (see Section 2.1.3). The concern is especially strong in this study wherein the correlations between house dust lead and blood lead, and between house dust lead and soil lead, were stronger than the correlation between soil lead and blood lead. To establish the importance of soil lead, it would have been worthwhile to first run the regression analysis without soil lead, followed by a run which includes the soil lead data. This would indicate whether soil lead is a substantial contributor to the variance in blood lead, i.e., does soil lead explain a portion of the blood lead variability that cannot be explained by house dust lead. Unfortunately this type of analysis was not conducted.

The Rabinowitz, et al. (1985) pair-matched data indicate that soil lead has, at best, only a small impact on blood lead (slope = $2.4 \mu\text{g/dl}/1,000 \text{ ppm}$ soil lead change). This result is consistent with the pair-matched studies described in Section 2.1.2 and, thus, lends further support to applying a slope factor of $2.0 \mu\text{g/dl}/1,000 \text{ ppm}$ to approximate the soil lead/blood lead relationship. Of note is a subsequent re-analysis of this data set by Rabinowitz and Bellinger (1988). Their analysis found a slope between soil lead and blood lead of $0.6 \mu\text{g/dl}/1,000 \text{ ppm}$ for children with a low degree of mouthing activity, and a slope of $1.6 \mu\text{g/dl}/1,000 \text{ ppm}$ for children with high mouthing activity.

B. Bellinger, D., et al. (1986) Correlates of low-level lead exposure in urban children at 2 years of age. *Pediatrics* 77:826-833.

Bellinger, et al. utilized the same data set of 249 children utilized by Rabinowitz, et al. (1985) (see preceding section) to correlate blood lead levels to five sets of nested variables related to lead exposure. The sets of variables were environmental lead sources, mouthing activity, home environment/care-giving style, child developmental status, and socio-

demographic factors. Multiple regression analyses found that the only significant predictors of blood lead were environmental lead sources, and to a lesser extent, mouthing behavior. They concluded that "the amount of lead in the proximate environment, particularly in house dust, emerged as the most important predictor." Soil lead was not included in their analysis, apparently because of the weaker relationship between soil lead and blood lead as compared to that between house dust lead and blood lead.

In total, the series of publications by this group (Rabinowitz, 1985; Bellinger, 1986; Rabinowitz, 1988) provide important evidence for a major role of house dust lead in determining children's blood lead, with a less important role attributed to soil lead. The slope factor for soil lead's effects on blood lead derived from these studies (1.6 - 2.4) is consistent with those found in other studies, but may be overestimated because of the strong correlation between soil and house dust lead, and because of the overriding importance of house dust lead in influencing blood lead.

3.17 Document 112:

Preventing Lead Poisoning in Young Children: A Statement by the Centers for Disease Control (1/85).

This CDC document is the source of the statement in the OSWER "Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Document 69) that "lead in soil and dust appears to be responsible for blood lead levels in children increasing above background levels when the concentration in the soil or dust exceeds 500-1,000 ppm". This statement forms the basis for the OSWER interim guidance, and for the Granite City ROD. However, as noted in Section 3.5, this statement in the CDC document was undocumented and was never intended to be used as a recommendation for a soil remediation action level. Further, where this statement appears in the ATSDR document (Document 85; Section 3.8), it is not supported by the referenced articles.

In making recommendations for preventing lead exposure in young children, the CDC suggests that "in severely contaminated residential areas, unless an effective barrier can be established between the children and the soil, surface soil must be removed and replaced with soil having a low lead content". This statement is the only recommendation made by CDC regarding soil lead. Therefore, a specific soil remediation recommendation was not provided, although the implication is that only "severely contaminated residential areas" are candidates for remediation.

3.18 Document 113:

EPA Fact Sheet, 5/88: Drinking Water and Lead.

The only information pertinent to the question of soil lead's influence on blood lead is a table showing that 30-50% of the total lead exposure in children may come from the combination of soil and dust lead. This table is not referenced. This apportionment of lead exposure to soil and dust does not directly bear on the soil lead/blood lead relationship because it does not discriminate between soil and house dust, and does not dictate what level of total lead exposure is considered detrimental.

3.19 Document 114:

Bellinger, D., et al. (1987) Longitudinal analyses of pre-natal and post-natal lead exposure and early cognitive development. New England J. Med. 316:1037-1043.

Bellinger, et al. measured pre-natal (umbilical cord) and post-natal (semi-annual beginning at 6 months) blood lead levels in Boston children, and related these values to the corresponding mental development index score for each child. This study does not provide any evidence or assertions concerning the relationship between soil lead and blood lead.

3.20 Document 115:

One editorial and two articles as follows:

1. Mahaffey, K.R. (1983) Source of Lead in the Urban Environment. Amer. J. Public Health 73:1357-1358.
2. Chaney, R.L., et al. (1984) The Potential for Heavy Metal Exposure from Urban Gardens and Soils. Source not clearly documented; additionally, it is unclear whether this is a publication or a report.
3. Mielke, H.W., et al. (1983) Lead Concentrations in Inner-City Soils as a Factor in the Child Lead Problem. Amer. J. Public Health 73:1366-1369.

1. Mahaffey (1983) provided an editorial comment on the importance of lead paint hazards and other environmental lead sources in causing elevations in childhood blood lead levels. The author points to a soil lead contamination study from Baltimore (Mielke, 1983; reviewed below in this subsection) to conclude that leaded gasoline is an important contributor to urban soil lead levels. In reviewing the routes for lead exposure in children, the author mentions produce from urban gardens and soil and dust ingestion. Additionally, the author's previous recommendation for a 100-150 µg lead/day intake is mentioned.

This editorial does not offer any new evidence regarding the soil lead/blood lead issue. The point raised concerning lead in garden produce has little practical importance to Granite City as pointed out in the IEPA (1983) analysis. The IEPA conclusion was that vegetables grown in the vicinity of the smelter do not appear to pose a significant risk. The other concerns expressed in this article have been addressed in a quantitative fashion in the RI report and TRC's use of the U/B model for Granite City.

2. Chaney, et al. (1984) reviewed the literature pertaining to lead levels in urban soils and produce, and pertaining to blood lead levels in children

ingesting lead in soil. The literature cited was generally supportive of a role for lead deposition in elevating crop lead levels, while lead uptake from soil into plants depends upon numerous factors such as soil pH, crop grown, and chemical form of lead. However, the review states that: "all evidence indicates that inadvertent soil ingestion allows much greater lead exposure than eating garden vegetables grown on the soil."

Regarding the soil lead/blood lead relationship, these authors cite evidence that excessive blood lead has been found in regions surrounding lead smelters. This evidence is not enough to incriminate a particular exposure pathway or lead source because smelter emissions simultaneously elevate soil lead, house dust lead and ambient lead.

The authors then cite various references to support their contention that blood lead is increased due to the ingestion of soil and dust lead by children. However, this review of the available literature did not make a case for either a low or high effect of soil lead on blood lead. Instead, the report states that when multiple linear regression techniques have been used to attribute exposure factors to blood lead, there has generally been low correlations found and " R^2 for multiple regression equations has varied from 11 to 50%." Thus, this review acknowledges the uncertainty and variability in the reported studies, which preempts a clear assignment of a particular slope value for the soil lead/blood lead relationship. This realization supports the need for a site-specific assessment of the nature and extent of a blood lead problem, with the need for a unique slope value developed for each site.

Thus, although the report argues that soil and dust ingestion are important routes for lead exposure in children, there is no effort made to distinguish between soil and house dust, and no inferences regarding the quantitative importance of soil lead are made. Therefore, this review does

not provide data or arguments that affect the setting of a lead in soil remediation standard.

3. Mielke, et al. (1983) studied the distribution of lead in soil in Baltimore and found that elevations in garden soil lead levels were clustered to the inner city area. The authors conclude that inner city children would be presented with higher levels of environmental lead contamination and risks of adverse health effect. However, the authors present no data or citations which support their contention that the lead in soil levels encountered in their study (median lead level was 100 ppm) might be unacceptably high.

3.21 Document 116:

Article by Louis Freedberg titled "Lead-laden Freeway Parks Hazardous to Kids" in the Neighborhood Works, Winter 1982 edition.

This article focuses upon the potential problem presented by citing public playgrounds near highways, especially in urban areas. The author alleges that the major hazard to children in freeway parks is not the airborne lead, but lead in the soil. The soil lead level which would be cause for concern was cited as 500 ppm, while he stated that "the medical community and local governments generally consider soil with 1000 ppm or more of lead as hazardous." However, no documentation is provided for these claims, nor is it stipulated which governments, physicians or researchers advocate which position regarding soil lead. In a sidebar attached to the article, two physicians are quoted, one who states that lead in soil poses a problem to children with pica, and the other who briefly discusses the relationship between blood lead and lead toxicity.

This article raises the issue of soil lead's affect on blood lead levels in children, but treats the issue in a very superficial manner. No

quantitative evidence is provided which would bolster a particular soil lead remediation standard.

3.22 Document 117:

Clark, et al. (1985) Condition and Type of Housing as an Indicator of Potential Environmental Lead Exposure and Pediatric Blood Lead Levels. Environmental Research 38:46-53.

Clark et al. studied blood lead levels in young children in relation to condition and type of housing, which reflects the potential for exposure to lead paint hazards. Lead in paint, exterior dust and house dust was measured; these environmental lead sources were found to correspond closely to the housing type and condition. Blood lead levels also corresponded well with housing characteristics in that the housing associated with the greatest lead paint hazards were also associated with the greatest blood lead levels. As the condition of homes worsened from satisfactory to deteriorating to dilapidated, the house dust, exterior dust and blood lead levels correspondingly increased. Multivariate regression analyses were not conducted, so it is impossible to estimate the relative contribution of exterior vs. interior dusts to the blood lead levels found. The children with the lowest blood lead levels lived in public housing, a housing type with low paint lead levels. These were the only children to live within close proximity to heavy traffic (interstate highway). Thus, in this study, the major factor governing blood lead elevations in young children was the degree of hazard due to lead paint, which had an overriding influence on indoor and outdoor dust lead levels. The data and analysis are insufficient to determine whether indoor or outdoor dust lead is the key influence in blood lead. However, this study indicates that in cases where paint lead is a hazard, it will likely be difficult to separate the effects of indoor and outdoor dust lead since both will be closely linked to blood lead.

3.23 Document 118:

Que Hee, et al. (1985) Evolution of Efficient Methods to Sample Lead Sources, Such as House Dust and Hand Dust, in the Homes of Children. Environmental Research 38:77-95.

This study presents a methodological advance made in advance of the Cincinnati longitudinal study. A method was developed to precisely collect and assay for lead in house dust, hand dust and surface dust in general. The data are not of direct relevance to the issue of the soil lead/blood lead relationship, except that methodological sampling issues are explored which have a bearing upon study results.

3.24 Document 119:

Silbergeld, et al. (1988) Lead and Osteoporosis: Mobilization of Lead from Bone in Postmenopausal Women. Environmental Research 47:79-94.

This study examined the possibility that lead stored in bone can be released into the bloodstream in women as a result of postmenopausal bone demineralization. This study has no data and no reference to data pertinent to the soil lead/blood lead relationship or the setting of a soil lead remediation standard.

3.25 Document 120:

Schroeder, et al. (1985) Separating the effects of lead and social factors on IQ. Environmental Research 38:144-154.

Schroeder, et al. studied variables believed to impact children's IQ scores to assess the importance of blood lead's effect on IQ. They found that initially, blood lead levels in 104 children ranged from 6-59 µg/dl, with IQ scores significantly correlated both to the blood lead level and to socio-economic status. A five year follow-up study conducted after a lead remediation program was implemented, showed that blood lead levels were

reduced such that all children had levels below 30 µg/dl. In this case, there was no statistically significant correlation between blood lead and IQ, although the relationships between socioeconomic status and IQ, and between maternal IQ and children's IQ, were significant.

This study is not directly relevant to the issue of soil lead's effects on blood lead, or to the proper soil remediation standard.

3.26 Document 121:

Needleman, et al. (1990) The Long-Term Effects of Exposure to Low Doses of Lead in Childhood. New England J. Medicine 322:83-88.

This study reports on an 11 year follow-up study of neurobehavioral function in 132 of 270 initially screened children who demonstrated a link between lead exposure and diminished function. The results suggest that the adverse neurological effects seen early in life do not readily reverse, but could lead to poor school performance. However, the initial (1979) lead levels in this cohort of affected school children was 34 µg/dl, which is well above the target blood lead levels set recently. Therefore, this study does not demonstrate that low level lead exposure, which produces blood lead levels of 10-15 µg/dl, is capable of producing the effects described.

3.27 Document 122:

McMichael, et al. (1988) Port Pirie Cohort Study: Environmental Exposure to Lead and Children's Abilities at the Age of Four Years. New England J. Medicine 319:468-475.

McMichael, et al. studied lead levels in umbilical cord blood and in blood at 6-24 months of age, in relation to neurocognitive abilities evaluated at four years of age. They found that blood lead levels in early childhood peaked at two years of age, and that post-natal blood lead levels, particularly at 2-3 years old, were inversely correlated to the development

scores measured at age four. The average blood lead in this population of children at 2 years of age was 21 µg/dl, indicating that the effects cannot be considered to occur at low levels of exposure. The study population resided in Port Pirie, Australia, which was impacted by a long-standing smelter.

There is no data in this study which relates lead in soil or other matrices to blood lead levels in children, and so this study is not relevant to the decision to remediate soil to 500 ppm.

3.28 Document 123:

Needleman, et al. (1984) The Relationship Between Prenatal Exposure to Lead and Congenital Anomalies. J. Amer. Med. Assoc. 251:2956-2959.

This article studied the relationship between umbilical cord blood lead levels and the incidence of congenital anomalies, while controlling for a variety of confounders which could affect the malformation rate. The authors did not relate any of the blood lead data or presumed effects to soil lead levels in the maternal environment. Therefore, this study has no relevance to the setting of soil remediation standards appropriate to protect young children.

3.29 Document 124:

Fulton, et al. Influence of blood lead on the ability and attainment of children in Edinburgh. The Lancet: May 30, 1987, pp. 1221-1225.

Fulton, et al. studied blood lead levels and cognitive abilities in a group of 501 6-9 year old children whose mean blood lead level was 10.4 µg/dl. Of note is the probability that blood lead levels in these children was appreciably higher than 10.4 µg/dl when they were 1-3 years old, which suggests that the effects measured in this study do not necessarily represent low level effects of lead. This study does not investigate or discuss the soil lead levels which might be needed to produce the effects seen, and so the

data are not of direct relevance to the soil lead/blood lead relationship or the setting of a soil lead remediation standard.

3.30 Document 125:

Bornshein, R.L. (undated) "Neurobehavioral Effects of Lead: A Summary of Cross-Sectional and Longitudinal Studies."

This report does not deal with the soil lead/blood lead relationship or soil lead effects on neurobehavioral parameters. Therefore, it is not directly relevant to the issue of setting a lead in soil remediation standard. However, its summary of the lead/neurobehavioral literature failed to find substantitative evidence for an adverse effect of low level lead exposure on standard test parameters. A major point is that sociodemographic correlates of parameters such as IQ are also closely correlated to blood lead, which makes the effect of lead questionable, especially at relatively low levels of exposure.

3.31 Document 126:

Rabinowitz, et al. (1985) Home Refinishing, Lead Paint, and Infant Blood Lead Levels. Amer. J. Public Health 75:403-404.

Rabinowitz, et al. used the same data set described in Document 110 to examine the role of lead paint hazards in elevating children's blood lead levels. Results showed that the amount of lead in indoor paint was significantly correlated with blood lead, and that in homes with lead paint, home refinishing activity could produce a 69% mean rise in children's blood lead. This study did not consider the influence of other environmental lead risk factors, but it does not indicate the potential importance of indoor lead sources in determining blood lead. The results are fully consistent with the Bellinger, et al. (1986) analysis of this data set which indicated that house dust is the major predictor of children's blood lead levels.

3.32 Document 127:

Bornschein, et al. (1986) "Exterior Surface Dust Lead, Interior House Dust Lead and Childhood Lead Exposure in an Urban Environment" presented at the Conference on Trace Metals in Environmental Health and was published in the conference proceedings (Trace Subst. Environ. Health 20:322-332, 1986).

This document is discussed in detail in Section 3.12 (Subsection B.2).

3.33 Document 128:

Wigg, et al. (1988) Port Pirie Cohort Study: Childhood Blood Lead and Neuropsychological Development at Age Two Years. J. Epidemiology Commun. Health 42:213-219.

Wigg et al. analyzed blood lead data in a lead smelter community in relation to scores of mental development. Blood lead surveys were conducted on over 600 children at birth through 2 years of age, and the results were compared to developmental scores taken at 2 years of age. The small effect seen (1.6 point decrement) in developmental tests per 10 µg/dl blood lead increase is of questionable clinical significance. This is especially true for low level lead exposure, since the weak effects seen were in a population of children which had current smelter-related lead exposure with a mean blood lead level of 21 µg/dl.

3.34 Document 131:

Report by Steele, et al. titled "Assessing the Contribution From Lead In Mining Wastes to Blood Lead," undated. This report appears to be a version of the manuscript that became published (same authors and title) in Regulatory Toxicology and Pharmacology 11:158-190, 1990.

This report evaluates the relationships between soil lead and blood lead in a variety of communities impacted by either mining and ore processing, urban pollution, or lead smelters. The report focuses on the problem that health assessments for lead in soil due to mine wastes are based upon epidemiological studies of populations impacted not by mining wastes, but to

urban pollution or to smelters. The possibility that the soil lead impact on blood lead may differ between these different types of exposure was investigated.

The report utilizes the slope value for the soil lead/blood lead relationship ($\mu\text{g}/\text{dl}$ per 1000 ppm change in soil lead) derived from a variety of studies to investigate differences between mining and other types of soil lead contamination. For smelter and urban communities 13 data sets indicated a range in slope values from 1.1 to 8.1 $\mu\text{g}/\text{dl}$ per 1000 ppm change in soil lead. However, included in this summary were the slope values from Angle and McIntire (1979) of 6.8; from Neri, et al. (1978) of 7.6 and 4.6; of Roberts; et al. (1974) of 5.0; from Reeves, et al. (1982) of 5.5; from Bornschein, et al. (1986) of 6.2; and from Rabinowitz, et al. (1985) of 8.1. These high slopes are misleading because of the problem that environmental data was not pair-matched to blood lead data (see Section 2.1.2) in the cases of Angle, et al. (1979), Neri, et al. (1978), and Roberts, et al. (1974). As discussed in Section 2.1.2, a bias towards high slope values is created by using data not pair-matched, and is a much less realistic representation of the variation in soil lead corresponding to a given distribution of blood lead values. The study by Reeves et al. (1982) cannot be used to estimate a soil lead/blood lead slope because it did not take into account the contribution from house dust lead or lead paint, even though elevations in blood lead strongly correlated to the presence of lead paint. The Rabinowitz et al. (1985) slope value of 8.1 appears to be a mistake, as the slope that can be derived from equations presented in the study is 2.4 (see Section 3.16). Additionally, Rabinowitz, et al. (1988) re-analyzed these soil lead/blood lead data and derived a slope of 0.6 to 1.6. It is noteworthy that this was a carefully controlled, pair-matched analysis (Section 3.16). The only other high slope value reported by Steele et al. was that of Bornschein, et al. (1986).

Although this study was pair-matched and accounted for numerous pertinent variables, the soil lead/blood lead analysis is questionable since there was no statistically significant relationship between soil lead and blood lead and the non-linear model used creates unrealistic and untested predictions of blood lead elevations for soil lead changes in the 0-500 ppm range (see Section 3.12).

The other soil lead/blood lead slope values reported by Steele, et al. (1990) were within the range of 1.1 to 3.0. In most cases (Yankel et al., Stark et al., 1982; Walter, 1980; Galke, et al., 1975) these studies were well-controlled pair-matched studies, and accounted for the key environmental lead sources.

It appears that in Steele, et al.'s effort to highlight the difference between smelter/urban areas vs. mining areas, in terms of the influence of soil lead on blood lead, the authors placed too much weight on studies which supported their thesis, but which were flawed in terms of the slope values produced. Steele, et al. does recognize that EPA determined that a reasonable estimate for the slope value for urban/smelter areas is 2.0 (EPA, 1986b).

The review of the soil lead/blood lead relationship for mining areas indicated that the slope value was low, and the authors discussed the possibility that this may be due to the poor bioavailability of lead contained in mining wastes.

3.35 Document 132:

Bellinger, et al. (1986) Low-Level Lead Exposure and Infant Development In the First Year. Neurobehavioral Toxicology and Teratology 8:151-161.

Bellinger, et al. relied upon the data base described under Document 110 to evaluate the relationship between blood lead and Mental Development Index scores in 249 children at 6 and 12 month of age. The study group was divided

into low, mid, and high blood lead subgroups with mean umbilical cord blood lead levels of 1.8, 6.5, and 14.6 µg/dl, respectively. Results indicated that postnatal blood lead levels were not statistically significantly related to the developmental indices studied. However, the umbilical cord lead levels were significantly related suggesting a role for pre-natal but not post-natal exposure in influencing neurological development.

These data were not related to soil lead data and no inference was made regarding the role of particular soil lead levels in producing the effects seen. Therefore, this study is not of direct relevance to the issue of soil lead remediation.

3.36 Document 134:

Telephone Record of a Conversation Between Louise Fabinski (Liaison, ATSDR) and J. Milton Clark (OHEA, Region V), Dated 3/30/90.

Louise Fabinski discussed the 500 ppm soil cleanup level for the NL-Taracorp site with her supervisors at ATSDR. The following quotes appear to represent the major conclusions from this telephone conversation. "ATSDR believes that a 500 ppm lead concentration in residential soils should not be necessarily interpreted as a safe level." "However, ATSDR is not objecting to EPA using the 500 ppm residential soil cleanup target at the NL-Taracorp site."

The basis for ATSDR's concern that the 500 ppm soil lead standard might not be protective, or for ATSDR's acceptance of Region V's soil clean up standard for this site, is not presented. It is noteworthy that ATSDR was not forthcoming in presenting a written, documented decision, nor did they openly support Region V's decision; instead they merely did not object to it. Therefore, ATSDR's position on this issue appears to be highly uncertain, and this is reflected in the health assessment that they conducted in 1989.

ATSDR's Preliminary Health Assessment for NL Industries/Taracorp Lead Site dated January 18, 1989 (Document 68, see Section 3.4) did not stipulate a particular cleanup action. Instead, ATSDR recommended that additional soil lead data in residential areas be collected and analyzed in terms of potential lead exposure to children. Thus, the Administrative Record does not contain any evidence of a clear ATSDR soil lead remediation decision for this site, but rather indicates ATSDR's uncertainty and desire for additional data.

3.37 Document 135:

USEPA, ECAO Document titled "Health Effects Assessment for Lead," dated 9/84.

This document provides a broad overview of many aspects of lead absorption and toxicity, and presents a lead risk assessment section. However, this section is not relevant to the issue of a soil lead remediation standard, because it does not consider the potential for uptake due to lead in soil, and how that uptake may affect blood lead or other parameters. Therefore, this document does not contain information or inferences that could be used to support a particular lead in soil standard.

3.38 Document 136:

USEPA, ECAO Document titled "Technical Support Document on Lead," dated 10/89.

This document was not reviewed because EPA did not make it available, asserting that it is classified as confidential.

APPENDIX A

ADMINISTRATIVE RECORD INDEX: NL INDUSTRIES/TARACORP
GRANITE CITY, ILLINOIS SITE

ADMINISTRATIVE RECORD INDEXNL INDUSTRIES/TARACORP
GRANITE CITY, ILLINOIS SITE

	<u>DATE</u>	<u>TITLE / DOCUMENT TYPE</u>	<u>AUTHOR</u>	<u>CONTENTS</u>	<u>PA</u>
1.	3/11/85	RI/FS Consent Order	N/A	Same as Title	48
2.	Various	Access File	N/A	RI Access Agreements and Summaries	78
3.	Various	Access File	N/A	RI-Phase II Access Agreements	8
4.	May 1986	"RI/FS Work Plan"	O'Brien & Gere	RI/FS Work Plan/ QAPP/Safety Plan	170
5.	5/6/87	Memo to Jerri Garl, U.S. EPA	Brad Bradley, U.S. EPA	Request for review of well locations	6
6.	5/20/87	RI Preliminary Results	O'Brien & Gere	Same as Title	25
7.	5/26/87	Letter to Brad Bradley	Ken Miller, IEPA	IEPA Comments on RI/FS Work Plan Addendum	4
8.	6/16/87	Letter to Stephen Holt, NL Industries	Brad Bradley	U.S. EPA request for and comments on Work Plan Addendum	3
9.	7/10/87	Revised Work Plan Addendum	Stephen Holt, NL Industries	Same as Title	8
10.	September 1988	"RI Report"	O'Brien & Gere	Same as Title	405
11.	1/10/89	RI Report Addendum	Brad Bradley	Letter approving and stating necessary changes to RI Report	5
12.	2/8/89	Meeting Notes	Brad Bradley/ O'Brien & Gere	NL Presentation of Remedial Response Objectives at meeting	7
13.	April 1989	"Alternatives Development Report"	O'Brien & Gere	Alternatives Array for the site	84

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14.	7/15/85	Letter to W.K. Weddendorf, NL Industries	John Hooker, IEPA	Comments on RI/FS Work Plan, Safety Plan	2
15.	7/24/85	Letter to W.K. Weddendorf, NL Industries	John Hooker, IEPA	Comments on GAPP	2
16.	7/30/85	Letter to W.K. Weddendorf, NL Industries	Neil Meldgin, U.S. EPA	Comments on RI/FS Work Plan	1
17.	8/19/85	Letter to W.K. Weddendorf, NL Industries	Neil Meldgin, U.S. EPA	Comments on GAPP	6
18.	8/23/85	Letter to Frank Hale, OB & G	W.K. Weddendorf	Transmittal letter of U.S. EPA and IEPA RI/FS Work Plan and GAPP Comments	13
19.	10/21/85	Letter to U.S. EPA and IEPA	W.K. Weddendorf	Response to U.S. EPA and IEPA RI/FS Work Plan and GAPP comments	21
20.	10/24/85	Letter to Frank Hale	W.K. Weddendorf	RI Soil Sampling Program Discussion	4
21.	11/25/85	Letter to W.K. Weddendorf	John Hooker	RI/FS Work Plan, GAPP Safety Plan Comments.	2
22.	12/11/85	Letter to W.K. Weddendorf	Brad Bradley	RI/FS Work Plan Safety Plan Comments	2
23.	12/17/85	Letter to W.K. Weddendorf	Brad Bradley	RI/FS Work Plan Safety Plan Comments	4
24.	12/20/85	Letter to Brad Bradley	John Hooker	RI Sampling Parameters	2
25.	1/14/86	Letter to U.S. EPA and IEPA	W.K. Weddendorf	RI/FS Work Plan Comment Timeframes	2
26.	2/4/86	Letter to U.S. EPA and IEPA	W.K. Weddendorf	Response to U.S. EPA and IEPA comments on RI/FS Work Plan	23
27.	5/6/86	Memo to file	Brad Bradley	Summary of 2/27/86 meeting between U.S. EPA/IEPA/NL Industries	3

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28.	3/4/86	Letter to Brad Bradley	Ken Miller, IEPA	Revised RI/FS Work Plan Comments	2
29.	3/24/86	Letter to Frank Hale	W.K. Weddendorf	Summary of changes necessitated by 2/27/86 meeting	2
30.	5/12/86	Memo to file	Brad Bradley	Summary of U.S. EPA/IEPA/NL Industries 4/9/86 QAPP Conference Call	19
31.	4/15/86	Letter to W.K. Weddendorf	Brad Bradley	Approval to commence RI Tasks 1 and 2	1
32.	6/26/86	Letter to Stephen Holt, NL Industries	Ken Miller	Comment on May 1986 RI/FS Work Plan	4
33.	7/30/86	Letter to Stephen Holt	Brad Bradley	Approval of May 1986 RI/FS Work Plan	11
34.	8/29/86	Letter to David Hill, O'Brien & Gere	David Payne, U.S. EPA	Requirements for QA Performance Evaluation Samples	1
35.	11/4/86	Letter to U.S. EPA and IEPA	Stephen Holt	RI Field Work Time Frames	1
36.	12/15/86	Letter responding to Holt's 11/4/86 letter	Brad Bradley	Same as Title	1
37.	4/9/87	Letter to Stephen Holt	Brad Bradley	Parameters to be analyzed for in groundwater in 2nd Quarter for RI	2
38.	4/24/87	Letter to Stephen Holt	Ken Miller	Data Reporting Requirements for RI Samples	2
39.	10/30/87	Letter to Stephen Holt	Brad Bradley	Approval for RI/FS Work Plan Addendum	1
40.	12/30/86	Memo to Norman Niedergang, U.S. EPA	David Payne, U.S. EPA	Performance Evaluation Sample Analysis	4
41.	3/11/88	Letter to Stephen Holt	Brad Bradley	Comments on Draft RI Report	43

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44.	6/6/88	Letter to U.S. EPA and IEPA	Stephen Holt	Soil Analysis and Final R1 Report Time Frames	2
45.	8/18/88	Letter to U.S. EPA and IEPA	Frank Hale	Draft R1 Report Risk Assessment Defense	5
46.	8/18/88	Letter to U.S. EPA and IEPA	Frank Hale	R1 QA Data Review Comments	3
47.	8/24/88	Letter to Stephen Holt	Brad Bradley	Final R1 Report Submission Schedule Approval	1
48.	9/7/88	Letter to Frank Hale	Brad Bradley	Risk Assessment Criticism Letter	3
49.	11/4/88	Letter to Stephen Holt	Brad Bradley	Necessary Changes to Final R1 Report	3
50.	11/30/88	Letter to U.S. EPA IEPA	Stephen Holt	Time Frame for NL Industries Response to 11/4/88 Bradley Letter	2
51.	12/14/88	Letter to Brad Bradley	Bonni Kaufman Donovan, Leisure, Newton & Irvine	Time Frames for NL Industries Response to 11/4/88 Bradley Letter	1
52.	12/16/88	Letter to U.S. EPA and IEPA	Bonni Kaufman Donovan, Leisure Newton & Irvine	NL Industries Response to 11/4/88 Bradley letter	23
53.	12/16/88	Letter to Brad Bradley	Ken Miller	IEPA Comments on U.S. EPA Procedures for Finalizing R1 Report	2
54.	2/1/89	Letter to Stephen Holt	Brad Bradley	Final Agency Action on Final R1 Report	6
55.	6/23/89	Letter to Stephen Holt	Brad Bradley	Comments on Alternatives Array Document	4

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57.	Various	Bi-Monthly Progress Reports	Stephen Holt	Same as Title	66
58.	5/28/85	Letter to U.S. EPA and IEPA	W.K. Weddendorf	Statement of NL Industries Project Coordinator	2
59.	4/13/89	"Cincinnati Soil Lead Demonstration Project"	University of Cincinnati	Same as Title	174
60.	April 1983	"Study of Lead Pollution in Granite City, Madison and Venice, Illinois"	IEPA	Same as Title	52
61.	September 1984	"A Land Pollution Assessment of Granite City/Taracorp Industries"	IEPA	Same as Title	64
62.	7/16/86	Letter to Frank Hale	Robert Crawford, Galena Industries	Lead Recovery Method	6
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64.	2/24/87	Letter to Sue Doubet, IEPA	John Coniglio, Envirodyne Engineers	RI groundwater Duplicate Sample Data	12
65.	6/12/86	Marble Lead Works Preliminary Assessment	Richard Lange, IEPA	Same as Title	18
66.	4/26/88	Letter to Stephen Holt	Ken Miller	Transmittal of Illinois Dept. of Public Health Soil Sampling Results and Lead health effects papers	160
67.	4/25/88	Letter to Brad Bradley	Ken Miller	Transmittal of Illinois Water Survey Data on Wells near the site	12

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69.	9/7/89	"Interim Guidance on Establishing soil Lead Cleanup Levels at Superfund Sites"	Henry Longest U.S. EPA	Same as Title	3
70.	October 1989	"International Lead Zinc Research Organization Environmental Report"	Same as Title	Same as Title	3
71.	5/13/85	Letter to Stanton Sobel, Taracorp, Inc.	W.K. Weddendorf	File Request	2
72.	3/5/87	Letter to Stephen Holt	Basil Constantelos, U.S. EPA	SARA Summary Letter	2
73.	8/24/88	Letter to Stephen Holt	Brad Bradley	RI/FS Guidance Transmittal letter	1
74.	8/30/89	Letter to Stephen Holt	Ken Miller	Well Survey Transmittal Letter	1
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76.	April 1988	"Title 35: Environmental Protection Subtitle C: Water Pollution"	IEPA	Illinois Regulations	106
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84.	2/1/84	"Lead Exposure and the Health Effects on Children"	Minnesota Department of Health	Same as Title	99 —
85.	July 1988	"The Nature and extent of Lead Poisoning in Children in the United States"	ATSDR	Same as Title	561 —
86.	Various	Notice Letter/PRP File	Various	Notice Letters and PRP Information	123
87.	5/1/86	Trip Report	Brad Bradley	Summary of findings during a site visit	2+photos
88.	7/26/89	Door-to-Door private well survey	Dave Webb, Illinois Dept. of Health and Ken Miller	Survey forms of wells in area of site	64
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94. 10/26/89	Letter to Stephen Holt	Ken Miller	Articles on Lead Uptake	16
95. 11/10/89	Letter to U.S. EPA and IEPA	Stephen Holt	NL Industries Response to 10/3/89 draft Preliminary FS Comment Letter	9
96. 2/8/90	Public Meeting Transcript	Jo Elaine Foster & Associates	Same as Title	91
97. 1/3/89	Letter to Ken Miller	Dennis Kennedy Illinois Dept. Transportation	Floodway and Proposed Construction at NL Site	1
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100.	3/12/90	Public Comment	Dames & Moore	Comment Regarding St. Louis Lead Recyclers	16
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102.	1/10/90	FS Report Addendum	U.S. EPA	Same as Title	24
103.	1/10/90	Proposed Plan	U.S. EPA	Same as Title	26
104.	None	Cost Calculations	U.S. EPA	Cost Calculations for Alternatives	3
105.	May 1987	"Review and Recommendations on a Lead in Soil Guidance"	Hazardous Contaminants Branch	Report to the Minister of the Environment	56 —
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109.	1987	"Toxic Effects of Lead in the Developing Nervous system: In Oculo Experimental Models"	B. J. Hoffer et al	Article from "Environmental Health Perspectives"	7 —
110.	None	Abstracts from "Medline/Lead"	Various	Listing of Lead studies	10 —
111.	Various	Excerpt from Integrated Risk Information system	None	Lead data	10
112.	January 1985	"Preventing Lead Poisoning in Young Children"	Centers for Disease Control	Same as Title	82 —
113.	May 1988	"Fact Sheet-Drinking Water and Lead"	U.S. EPA	Lead Data	4 —
114.	4/23/87	"Longitudinal Analyses of Prenatal and Postnatal Lead Exposure and Early Cognitive Development"	D. Bellinger et al	Article in "New England Journal of Medicine" Same as Title	7
115.	Various	Articles	Various	Three Articles Entitled "Sources of Lead in the Urban Environment," "The Potential for Heavy Metal Exposure from Urban Gardens and Soils," and "Lead Concentrations in Inner-City Soils as a Factor in the Child Lead Problem"	27 —
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118.	3/13/85	"Evolution of Efficient Methods to Sample Lead Sources, such as House Dust and Hand Dust, in the Homes of Children"	S.S. Guettee et al	Same as Above	10 —
119.	3/1/88	"Lead and Osteoporosis: Mobilization of Lead from Bone in Postmenopausal Women"	E.K. Silbergeld	Same as Above	13 —
120.	December 1984	"Separating the Effects of Lead and Social Factors on IQ"	S.R. Schroeder	Same as Above	11 —
121.	1/11/90	"The Long-Term Effects of Exposure to Low Doses of Lead in Childhood"	Needleman et al	Article in "The New England Journal of Medicine" Same as Title	6 —
122.	8/25/88	"Port Pirie Cohort Study: Environmental Exposure in Lead and Children's Abilities at Age of Four Years"	McMichael et al	Same as above	8 —
123.	6/8/84	"The Relationship between Prenatal Exposure to Lead and a congenital Anomalies"	Needleman et al	Article in "JAMA" - Same as Title	4 —
124.	5/30/87	"Influence of Blood Lead on the Ability and Attainment of Children in Edinburgh"	Fulton et al	Article in "The Lancet" - Same as Title	6 —
125.	None	"Neurobehavioral Effects of Lead"	R.L. Bernschein	Same as Title	15 —
126.	April 1985	"Home Refinishing, Lead Paint, and Infant Blood Lead Levels"	Rabinowitz et al	Article in "AJPH" - Same as Title	2 —

	<u>DATE</u>	<u>TITLE/DOCUMENT TYPE</u>	<u>AUTHOR</u>	<u>CONTENTS</u>	<u>PAGES</u>
127.	June 1986	"Exterior Surface Dust Lead, Interior House Dust Lead and Childhood Lead Exposure in an Urban Environment"	Bornschein etal	Same as Title	13 —
128.	1988	"Port Pirie Cohort Study: Childhood Blood Lead and Neuropsychological Development at age 2 years"	Wigg etal	Article in "Journal of Epidemiology and Community Health" -Same as Title	78 —
129.	3/12/90	Public Comment	Bradley O'Brien, Gardner Carter, & Douglas	Comment regarding NL Industries Public Comment	1
130.	None	Drawing	U.S. EPA	Sketch of possible Final contours for Expanded Taracorp pile	2
131.	None	"Assessing the Contribution from Lead in Mining Wastes to Blood Lead"	Steele etal	Same as Title	40 —
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134.	3/30/90	Conversation Record	Wilt Clark U.S. EPA	Record of conversation with ATSDR regarding soil lead clean up levels	1

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135.	September 1984	"Health Effects Assessment for Lead	Environmental Criteria and Assessment Office, U.S. EPA	Same as Title	45 —
136.	October 1989	"Technical Support Document on Lead"	Environmental Criteria and Assessment Office, U.S. EPA	Same as Title	78 —

Attached is a Compendium of CERCLA Response Selection Guidance Documents, which is part of this Index.

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KEY DOCUMENTS AND CITATIONS INDEX

KEY DOCUMENTS AND CITATIONS INDEX¹

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¹ This is a list of locations within this report where these documents have been discussed. For full citations, see Reference List, Section 4.0.

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WILLKIE FARR & GALLAGHER

Washington, DC
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December 26, 1990

VIA FEDERAL EXPRESS

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Re: NL Industries/Taracorp Superfund Site,
Granite City, Illinois

Gentlemen:

In accordance with Paragraph VIII 30 of the Administrative Order for Remedial Design and Remedial Action ("Order") issued in this matter, NL Industries hereby gives notice that it intends to comply with the Order by undertaking the following tasks specified in NL's August 10, 1990 good faith offer:

- a. Demographic study of the population of Granite City.
- b. Blood lead study of the population of Granite City.

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Washington, DC 20036-3302
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- c. Home inspections to identify possible sources of lead exposure.
- d. Investigation of the distribution of lead-bearing soils in Granite City.
- e. As an extension of tasks a-d above, development of a plan for a risk assessment for the site that is acceptable to U.S. EPA and implementation of the plan, if deemed appropriate by U.S. EPA.
- f. Development of a system for monitoring the ground water.
- g. Inspection of driveways and alleys in selected neighborhoods for battery casing materials.
- h. Recycling, if possible, of the drums from the Taracorp pile.
- i. A treatability study of the battery casing material.
- k. Design of a cap for the expanded Taracorp pile.
- l. Development of environmental contingency plans for actions to be taken in the event that future monitoring data indicate that air or ground water is found to be contaminated by releases from the site in the future.
- m. Development of a dust control plan for use during all remedial construction activities to mitigate the release of contaminated soils.

In addition, NL proposes to undertake a pilot study to determine the efficacy of deep tilling lead-bearing off-site soils to achieve a 500 ppm level as an alternative to excavation of such soils. The pilot study is discussed in more detail below.

NL has sufficient cause for declining to comply with the provisions of the order requiring excavation of off-site soils in nearby residential areas in accordance with sections 106(b)(1) and 107(c)(3) of CERCLA, 42 U.S.C. § 9606(b)(1) and § 9607(c)(3) for the following reasons.

1. The basis for the 500 ppm cleanup level has not been scientifically established in the administrative record.

NL has submitted several previous comments to this record which establish that EPA has no scientific basis for requiring soil excavation to a 500 ppm level. ¹ NL believes these comments demonstrate that it has sufficient cause for noncompliance with those provisions of the administrative order requiring excavation lead in soil to a 500 ppm level.

In addition, the phased action approach to determine lead clean-up levels recently recommended by the Society for Environmental Geochemistry and Health (SEGH) makes clear that additional information is required before a scientifically-defensible cleanup level for lead in soils can be determined. See SEGH "Lead in Soil" Task Force, Recommended Guidelines, (DRAFT) (attached). This approach requires a thorough investigations of the blood lead levels of the community that is judged to be at risk and the contributions to blood lead from soil and other sources prior to selection of a remedial action. On the basis of the results of these investigations, an appropriate soil clean-up level that is protective of public health is then scientifically determined. The Administrative Order does not specify that such investigations will be performed, nor does it allow for modification of the soil cleanup criteria in response to the results of such investigations. Instead, the order arbitrarily selected a 500 ppm clean-up level without adequate scientific support or analysis of site specific conditions. Clearly, NL has sufficient cause for noncompliance with the provision of the Order calling for implementation of this clean-up level.

¹ These comments include a 12/16/86 letter to Brad Bradley from Bonni Kaufman; the 3/12/90 Public Comments of NL Industries on the Proposed Plan for the Taracorp Superfund Site, Granite City, Illinois; and the 8/30/90 NL Industries Good Faith Offer.

2. A pilot study to determine the effectiveness and efficacy of deep tilling as a remedial technology for this site should be performed before the selection of a remedial alternative is finalized.

The recent SEGH report suggests that deep tilling can be used to mix the contaminated surface soils with clean sub-soil, thereby reducing the lead levels in the soils to which the community is exposed. The SEGH report notes that use of deep tilling as a remedial technology can eliminate the need for excavation and disposal of contaminated soils. A preliminary investigation of the suitability of tilling as a remedial technology for the Taracorp site indicates that there are a number of reasons why deep tilling may be a better method of remediating the residential-area soils at the Taracorp site than the excavation method specified in the Administrative Order. This investigation suggests that:

- a. A remedial action based on deep tilling can be developed that is protective of human health and consistent with all of the ARARs for this site.
- b. Tilling can be used to attain safe soil lead levels in a much shorter time than will be needed for excavation, resulting in less disruption to the community. Because tilling can proceed more quickly than excavation, the period of high lead exposure resulting from implementation of the remedy will be shorter, resulting in lower exposures and health.
- c. Substitution of deep tilling for excavation will greatly reduce or eliminate the need for heavy truck traffic through the residential portions of the community. This will result in a lower risk of traffic fatalities and injuries, air pollution due to vehicle emissions and airborne lead exposure from transportation of lead-bearing soils through the community.
- d. Tilling can permanently reduce the concentration of lead in surface soils to safe levels in a considerable portion of the residential area to be remediated, at a significantly lower cost than will be incurred by excavating. Tilling to a depth of twelve inches is feasible and is expected to result in average lead concentrations in surface soils that are within a 500 ppm range.
- e. A pilot project to determine the efficacy of tilling for the Taracorp site could be performed

in a few months in parallel with the Remedial Design tasks. Performance of the pilot study would not delay the development of an appropriate remedial design. Moreover, if the pilot-project is conducted in areas where the community's children are most exposed (e.g., playgrounds), it would result in an immediate reduction in such exposure.

3. The basis for the 500 ppm level was not subject to dispute resolution or public review prior to issuance of the Record of Decision.

NL voluntarily entered into an Administrative Consent Order (Consent Order) for conduct of a remedial investigation feasibility study at this site with EPA and the Illinois Environmental Protection Agency in May, 1985. The Consent Order scope of work negotiated and agreed to by the parties required NL to undertake a site-specific risk assessment, incorporating previous sampling, blood tests and health studies undertaken at the site. During the next five years, NL fully complied with the terms of the Consent Order, conducting three separate site-specific risk assessments, supervised by U.S. EPA and subjected to peer review scrutiny. NL submitted the preliminary feasibility study report in August, 1989, concluding that a 1510 ppm soil lead level for residential areas was protective of public health and the environment and conservatively used a 1,00 ppm soil lead level to select residential neighborhoods targeted for remediation.

NL received comments from U.S. EPA and IEPA on October 4, 1989 arbitrarily rejecting the previously approved and legally required risk-based approach to remediation of the site. The agencies instead proposed a 500 ppm level for residential soils and a 1,000 ppm level for industrial areas based on their interpretation of U.S. EPA Interim Guidance on Establishing Soil Lead Clean-up Levels at Superfund Sites issued in September, 1989. NL responded to these comments in compliance with the Consent Order on November 10, 1989, but U.S. EPA, without explanation, refused to enter into dispute resolution to resolve the differences in the two approaches, in direct contravention of Paragraph 17 of the Consent Order.

On January 10, 1990 U.S. EPA further breached the Consent Order by releasing NL's August, 1989 study, with an addendum prepared by EPA selecting Remedial Alternative H. U.S. EPA's selection of a remedial alternative prior to NL's receipt of comments required by Paragraph 17 of the Consent Order and the conclusion of dispute resolution procedures was clearly unlawful and constitutes sufficient cause for non-compliance with the unilateral order.


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In addition, EPA has relied on the application of the Integrated Uptake/Biokinetic (IU/BK) Model as a basis for the 500 ppm lead-in-soil clean-up level in the Record of Decision. The IU/BK model was not used to support EPA's Proposed Plan for Remedial Alternatives at the site released for public comment on January 10, 1990 and was not listed as a reference therein. Therefore, there was no opportunity for public review of EPA's use and application of the model at the site, prior to issuance of the Record of Decision, in direct contravention of Agency policy.

Finally, NL would note that Paragraph XXVI of the Order for Remedial Design and Remedial Action requires an opportunity to confer on the implementation of this Order. At the conference scheduled for this purpose on December 21, 1990, the Agency's toxicologist for this site was not present. NL believes this lack of scientific expertise prevented a scientifically valid analysis of NL's comments and proposal by the Agency.

For these reasons, NL does not believe it is required under CERCLA to comply with the provisions of the Order requiring excavation of lead in soil to a 500 ppm level. NL, in cooperation with the other recipients of the Order, hereby offers to comply with all other requirements of the Order as specified in its good faith offer submitted on August 10, 1990 and in addition conduct the pilot study of deep tilling. Since EPA's acceptance of this proposal will impact and require modification of the provisions of the Order, NL reserves the right to comment on specific language in the Order should the Agency allow NL to proceed.

Sincerely,



Steven A. Tasher
Bonni Fine Kaufman
Counsel for NL Industries, Inc.

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SOCIETY FOR ENVIRONMENTAL
GEOCHEMISTRY AND HEALTH

"LEAD IN SOIL" TASK FORCE

RECOMMENDED GUIDELINES

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**SOCIETY FOR ENVIRONMENTAL
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EXECUTIVE SUMMARY

The lack of well founded guidelines in the United States and other countries for lead in soil, coupled with the confusion over exposure to lead, a special task force was formed by the Society for Environmental Geochemistry and Health (SEGH) to develop a report on recommended guidelines for lead in soil. The fourteen member task force is composed of SEGH members representing a balance between the regulatory agencies, industries, medical and public health profession and recognized researchers from the scientific community concerned with lead in soil.

In an attempt to make the report user friendly the opening section presents a simplistic outline of how to use this report. Emphasis is placed on the logical sequence to be followed as set forth in a "Phased Action Plan" and an "Appropriate Target Blood Lead Criteria" which has been developed into a management strategy for lead in soil. The rationale for each module in the decision matrix is outlined and explained (with documentation) in the Phased Action Plan section.

A formula has been derived for the selection of the appropriate target blood lead criteria (TBL which will then trigger the decision process as well as govern the cost of necessary remedial actions. Various levels of target blood lead criteria are used to illustrate how the TBL may be applied to the PAP to determine guidelines for site specific situations. The detailed rationale for this model is discussed and illustrated with examples.

The Health section of the report has focused on population groups at risk for adverse health effects of lead.

Studies in many parts of the world, particularly those conducted during the past 15 years, have clearly identified the fetus and young child as the population groups at greatest risk for adverse health effects of lead. Because lead freely crosses the placenta, women of child-bearing age, as surrogates for the fetus, have also been identified as a high risk population group. Small but statistically significant increases in blood pressure have been found in middle-aged white males, as well as a small but significant increase in PbB in post-menopausal women; however, these last two groups are not considered to be at risk due to exposure to lead in soil. With regard to fetal exposure, recent studies show a significant reduction in gestational age that is inversely related to cord and maternal PbB levels. Some, but not all, studies have also shown a modest reduction in birth weight at blood lead levels $> 12-13 \mu\text{g}/\text{dl}$. Infants born with PbB $> 10 \mu\text{g Pb}/\text{dl}$ have shown impaired mental development at least until two years of age. Several cross-sectional studies in children at 6 or 7 years of age have shown a significant reduction in verbal IQ scores, and furthermore, the verbal IQ scores remain normally distributed, so that the IQ of an overexposed population is shifted downward throughout the range, thereby reducing the number of children of superior intelligence and increasing the number of children classified as mentally retarded. In these studies, dentine lead in shed deciduous teeth has served as the marker of a chronic cumulative dose of lead

during the early school years. One of these studies, in which children were reevaluated at 18 years of age, indicated that those with the higher dentine lead levels were 7.4 times more likely to have dropped out of high school, and 5.8 times more likely to have a reading disability as young adults, as compared with those with low dentine lead levels. The data, both in children and experimental animals, are consistent in indicating that the subtle, neurobehavioral adverse effects manifested primarily by learning disabilities are long-lasting, and very likely to be permanent.

The primary target organs for lead are the central and peripheral nervous system, the hematopoietic system, and the kidney. As recently as a decade ago, the hematopoietic system was considered the critical organ, or the one most sensitive to the adverse effects of lead. Recent studies have revealed that the developing nervous system is just as sensitive as the hematopoietic system, if not more sensitive. The developing nervous system is now classified as the critical organ, primarily because the adverse effects of lead on the nervous system do not appear to be reversible, while those on the hematopoietic system clearly are reversible. Significant adverse effects of lead on the kidney are found only at higher levels in relation to prolonged exposure. At the present time, at least in children, significant, long-lasting adverse effects of lead on the kidney have not been found.

The endogenous factors which effect the susceptibility of the fetus and young child to appear to be two-fold: 1) the young

organism absorbs dietary lead from the intestinal tract at a much higher rate than does the adult. In the adult, approximately 10% of dietary lead is absorbed, very little of which is retained. By contrast, metabolic balance studies in infants show that about 50% of dietary lead is absorbed. When the dietary lead intake exceeds 5 $\mu\text{g}/\text{Kg}$ of body weight per day, the infant is in positive lead balance. Studies in adults have indicated that the absorption of lead is increased by a factor of 3-5 when lead is administered in the fasting state. It would be unethical to conduct such studies in children. These factors, together with the very rapid growth rate, particularly of the neural system in infancy and early childhood, combine to render the child and fetus the population group at highest risk for overexposure to lead and its adverse effects.

Infants and children from birth to 6-7 years of age constitute the group at greatest risk for exposure to lead in soil. Within this overall age group, children between 6 and 36 months of age are perhaps the sub-group at highest risk. This is primarily because of developmental and behavioral considerations. It is in this age group that hand-to-mouth activity, including the mouthing and/or ingestion of non-food items, is considered a part of normal development and one of the means by which the infant and young child explore their environment. Between 6 and 12 months of age, infants begin to scoot, crawl and walk, thereby enabling them to move freely about the home, during which time they become more highly exposed to lead in interior household dust. Later on, perhaps at 4-6 year of age, they begin to go

outside and so become exposed directly to soil. In all groups, a portion of the interior household dust represents lead from exterior soil which has been tacked in to the home, as well as blown in through open windows and doors. Infants and toddlers receiving inadequate social and physical stimulation may indulge in a greater amount of hand-to-mouth activity than those similarly exposed to lead in dust and soil but for some the quality of care-giving is higher. General cleanliness of the home also has been shown to influence PBB levels in children. This is particularly important for children under 3 years of age, who spend perhaps 80-90% of their time inside the house.

Measurement of the concentration of lead in whole blood provides an indicator of the internal dose of lead, and in epidemiologic surveys has served as the most widely used indicator of lead absorption for the past 20-30 years. The total amount of lead in whole blood at any point in time is the sum of both recently absorbed lead and lead absorbed in the past. Lead can and has been measured in urine and hair; however, such measurements in children are of no value for epidemiologic purposes. The definition of acceptable blood lead concentration has changed substantially during the past half-century. Historically, acceptable blood lead concentration has been defined as that concentration below which adverse health effects, as perceived at the time, were not likely to occur. For example, as recently as 1960 [?] Pb/dl whole blood was considered the upper limit of normal in children. This was passed upon the observation that acute clinical manifestations and changes by x-

ray in the long bones were not likely to be seen at lower levels. By the 1970's, it was noted that the blood lead threshold for increasing urinary output of coproporphyrin and delta aminolevulinic acid (substances which are increased in lead poisoning) was at the blood lead concentration of approximately 40 $\mu\text{g Pb/dl}$ whole blood. The Surgeon General of the United States at that time recommended that the upper limit of normal blood lead concentration be lowered to 40 $\mu\text{g Pb/dl}$ whole blood. The critical effect concept, as described in the report of the Subcommittee on the Toxicology of Metals of the Permanent Commission and International Association of Occupational Health, provided the scientific rationale and practical approach for the prevention of lead toxicity. Under this concept, if the critical or earliest measurable adverse effect could be identified and effective action taken, then later and more serious effects could be prevented. At the time this report was issued in 1976, the developing erythroblast in the bone marrow was considered the cell most sensitive to lead. More recent studies indicate that the developing nervous system is at least as sensitive, if not more sensitive, than heme synthesis in the bone marrow. Furthermore, the adverse neurodevelopmental effects of lead appear to be permanent, so that this is now considered the critical effect of lead. Recent studies indicate that the threshold for adverse health effects on the developing nervous system lies at the blood lead concentration of 10 to no higher than 15 $\mu\text{g Pb/dl}$ whole blood. It is anticipated in the United States that the responsible government agencies will re-define

the upper limit of acceptable blood lead concentration at a lower level of 10-15 $\mu\text{g Pb/dl}$ whole blood.

Lead is a multi-media substance. When any survey is undertaken to evaluate exposure to lead in soil, other potential sources of lead for a particular population must be taken into account. In the United States, there have been substantial reductions in lead in air and food, which have been associated with substantial reductions in blood lead concentration. A similar natural lowering of blood lead concentration has also been noted in the United Kingdom. It is now generally considered that the major sources of lead for children are lead in soil, household dust, and paint. In some areas, where drinking water is "plumbosolvent" and "aggressive", drinking water lead may be a significant source. There are a number of sources, such as cottage industries and hobbies involving the making of pottery, other ceramic ware and art glasswork, that lead to gross overexposure within such homes. In some ethnic groups, folk medicines have been a cause of serious lead poisoning. In the United States at least, lead based paint ingested repeatedly by children has lead to clinical poisoning, including fatalities.

Bioavailability is discussed in regard to the amount of lead in a diet that may be absorbed into the blood stream. Factors that may influence whether lead in soil and dust ingested by children is absorbed into the blood include the physical and chemical properties of the particles, and nutritional status of the children. Another important consideration is the effect of increasing soil dose on lead absorption.

Lead absorption studies in children and adults have contributed to a better understanding of human lead absorption. Larger lead particles were found to have a lower toxicity than small particles or other compounds. The implications of these findings are that larger lead particles dispersed by mining would be expected to have a significantly lower bioavailability than other soil lead.

Iron deficiency was found to strongly affect lead absorption and an important finding was that lead absorption is greatly reduced by simultaneous ingestion of food. There was also a clear interaction between dietary calcium and phosphorus in animal and human studies.

Bioavailability studies of lead in soil and dust indicated that the chemical form and larger particle size of mining wastes was a possible reason for the reduced impact of lead sulfide in contaminated soils.

Stomach pH was evaluated as a factor in lead absorption and it was found that food and soil can buffer the pH of the stomach to levels around 6 which greatly reduces the dissolution of environmental or soil lead.

A section on risk management focused on the exposure assessment and development of a relationship between blood lead levels and the levels of lead in soil as a possible source of exposure. Blood lead levels were found to be impacted by exposure to other sources in water, food, paint and others.

Overall risk assessment was suggested on a site specific basis concerned with economic, legal, political and social

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factors. Risk communication is presented as a new policy focused on the different perceptions between the scientific and lay public concerning risk.

Uncertainties and non-technical considerations that must be used by the risk manager include the number and age of the population, present and future land use, and social-economic status of area residents.

Key factors associated with understanding the geographic distribution of lead in soil include rural background lead levels and contributions from aerosol sources of lead associated with 1) point, 2) linear, and 3) area sources. Patterns of lead were found to be complex but it was felt that soil lead and blood lead were related.

Legal aspects of lead in soil were examined in regard to the levels associated with the clean water, clean air and other standards. It was noted that the EPA has not established a reference dose nor set an acceptable daily intake level for lead. This inconsistency has prompted the EPA's Office of Solid Waste and Emergency Response (OSWER) to advise the regions to use the Centers for Disease Control (CDC) guidance of 500 to 1000 ppm for lead clean-up decisions.

Liability was examined in regard to the risk of having a person injured at a "cleaned-up" lead contaminated site. It was noted that the government or parties responsible for clean-up (or contamination) of the site would become the most likely target.

Economic considerations in establishing lead levels were evaluated on a cost-benefit analysis made on a case-by-case

basis. Financial resources need to be determined before a remedial plan is established.

Remedial actions to treat soil were examined for soil 1) removal, 2) containment, 3) contaminant extraction, 4) deep tilling and 5) revegetation, barriers or zoning. The cost of no action was also examined in regard to detrimental impacts of lead exposure on populations at risk.

Suggested methods for soil sampling and analysis are to be found in the report supplements. The protocol and examples given should be of applied value in experimental design and sampling to determine soil lead levels.

I. HOW TO USE THIS REPORT

The purpose of this report is to put a user friendly working document into the hands of public health officials, regulatory agencies, industrial environmental managers and others concerned with the question of how to determine if they have potential health problems with lead in soil. As a useful working outline, the report has been divided into sections that start with an introduction as to why the report was developed. The introduction is then followed by a section containing definitions used in the report to assist the reader in understanding the meaning of specialized terms used.

The report then presents a protocol or logic format which may be used in a step wise progression through six major areas as shown in Figure 1 and entitled as the Phased Action Plan. The first series of determinations concentrate on assessing if there is a Problem with lead in soil as indicated through steps A through D:

1. Unplanned elevated soil lead samples which may indicate a problem in the specific area being sampled (Step A).
2. Unplanned elevated blood lead (PbB) values which might arise from clinical investigations (Step B).
3. Unplanned discovery of lead in animal or plant tissues or indications of lead toxicity in domestic animals or wildlife (Step C).
4. Anticipated potential lead in soil problems on land that was previously used for industrial use and would be suspect in regard to lead contamination (Step D).

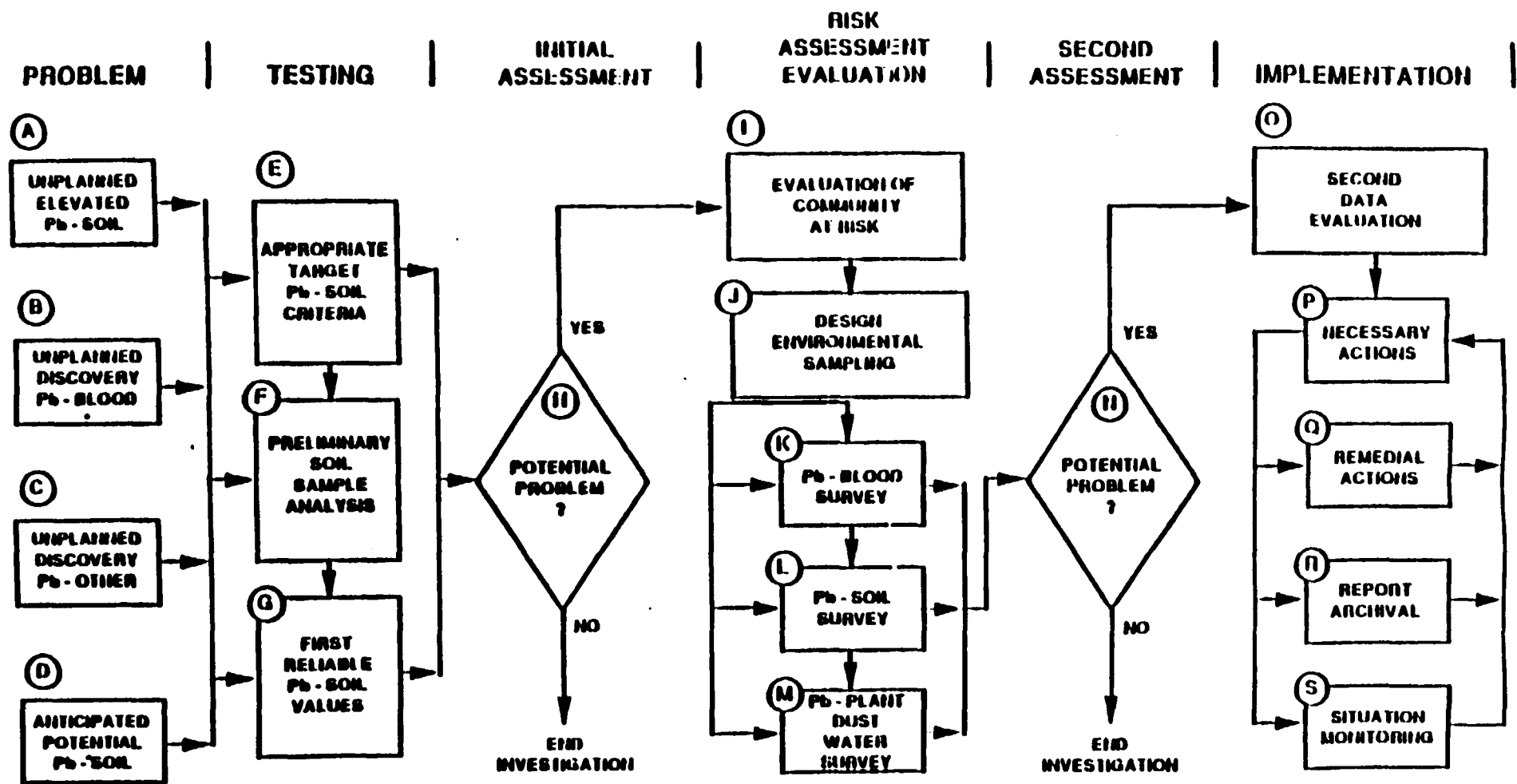


Figure 1. Phased action plan for lead in soil

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If any of these problems are found to be present, then the protocol moves to the second area entitled Testing which requires the use of:

1. A Soil/dust guideline based on blood lead guidelines. The relationship used is derived as explained in Figure 2 along with a series of examples and rationale which are discussed in detail in the health section of the report (Step E).
2. Preliminary soil sampling and analysis must then be carried out to characterize soil lead levels in the area under investigation. Recommended methods for soil sampling and analysis are to be found in the back of the report as a supplemental section concerned with this subject (Step F).
3. First reliable soil lead values may then obtained from the preliminary soil sampling and analysis which allows one to characterize the area for the next level of the decision making process (Step G).

The third area in the action plan requires an initial assessment of the Potential Problem based on the data obtained and target levels chosen and a decision made to either end the investigation or proceed to the Risk Assessment Evaluation area (Step H).

The risk assessment evaluation contains a series of steps to be made consisting of:

1. Evaluation of the community at risk to determine factors such as the number and age of the population at risk, land use and comprehensive sampling, to list a few. The supplemental section of the report may again be used

- concerning detailed sampling and analytical methods appropriate for use on a site specific basis (Step I).
2. Design environmental sampling to provide a general description of the project including necessary details associated with time tables and tasks, use of data, project organization and responsible individuals (Step J).
 3. A blood survey would then need to be designed and performed by appropriate medical personnel utilizing a laboratory with an acceptable quality control program (Step K).
 4. A soil lead survey would need to be made for those areas indicated by the risk assessment and environmental design. Details on sampling and analysis are again to be found in the special supplemental sections of the report dealing with sampling methods (Step L).
 5. Surveys of lead in dust, vegetation and water also to be conducted by methods as illustrated in the supplemental sampling and analysis section of the report (Step M).

The Second Assessment decision is then based on the evaluation of information gained during the risk assessment evaluation. At this time a decision must again be made on either to end the investigation or to proceed to the implementation (risk management) stage (Step N).

The implementation process requires the consideration of:

1. A second data evaluation now need to be considered in terms of financial resources available for the various actions to be taken (Step O).

2. Necessary actions as addressed through a site specific risk management decision process. Details concerning how to develop a risk management strategy are noted in the section of the report dealing with this subject (Step P)
3. Remedial actions, if prescribed, must then consider a number of issues which are further described in the risk management section of the report (Step Q).
4. Report archival notes the requirement that all data collected and evaluated should be retained in an appropriate location for possible future use as necessary (Step R).
5. Situation monitoring requires that the site continue to be monitored in a planned fashion to determine the effect of clean up actions (Step S).

Further details on the various steps as described in this format are to be found in the Phased Action Plan section of the report.

The Health section of the report details concerns of the population groups at risk, definitions of acceptable blood lead concentrations, discussions on other sources of lead and evaluations of appropriate case studies that may serve as an example. The use of health criteria in deriving the target soil/dust lead guideline concentration model should be carefully examined since this is the model used to determine the appropriate target soil lead/blood lead action level in the Phased Action Plan. Since a single number is questionable the examples given will help in understanding how the model and number range derived may be applied to different situations.

The bioavailability of lead has now become a major area of concern evaluating the impact of lead in regard to human health. The section concerned with this subject describes the factors that influence the bioavailability of lead in regard to chemical composition, particle size and other nutritional factors.

Descriptive information relating to the overall analysis of risk as associated with the suggested soil lead guidance is presented in the risk management section of the report. Possible remedial actions and associated cost considerations will be of interest to anyone concerned with implementing necessary actions to protect human health.

Recommended methods presently in use for soil sampling and analysis are presented in the report as supplements. These methods and sampling designs should be of applied value for use in various site specific evaluations that require quality control and the use of soil data for further evaluation and use in the Phased Action Plan matrix.

It is hoped that this report will be of applied value to decision makers concerned with lead in soil.

II. INTRODUCTION

There is a lack of well founded guidelines in the United States and other countries for evaluating concentrations of lead in soil in terms of a possible impact on human health. This has contributed to confusion among regulatory agencies, industries, public health officials, the medical community and citizens concerned with evaluating or remedying lead contaminated soils. Public health officials and the medical community are expected to judge the health effects and risks from lead exposure. They must also decide the soil lead concentration that should be used as a basis for requiring remedial action at contaminated or hazardous waste sites. There is a clear need for better founded guidelines and this was emphasized in a special session of the 1987 Trace Substances in Environmental Health Conference held in Columbia, Missouri, U.S.A. following a key note presentation on "Lead in Soil: How Clean is Clean?" by Davies and Wixson (1986). As a result of the questions raised and the continuing urgent concern expressed, a special conference focusing on "Lead in Soil: Issues and Guidelines" was held in Chapel Hill, North Carolina in March 1988. Cooperating sponsorship was provided by the Society for Environmental Geochemistry and Health (SEGH), the United States Environmental Protection Agency (EPA), the International Lead Zinc Research Organization (ILZRO), the Lead Industries Association (LIA) and Clemson University, South Carolina. Over thirty scientific papers were presented to summarize pertinent scientific data, to examine previous and on-going lead in soil

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case studies and to evaluate guidelines or scientific approaches used in countries throughout the world. The conference featured panel and audience discussion on suggestions for possible approaches to be used in the development of U. S. guidelines for lead in soil. A "phased-action plan" approach was proposed by Wixson (1988) and accepted by the participants together with a request that a Society for Environmental Geochemistry and Health (SEGH) task force be formed to evaluate further the conference findings and to develop a report that would recommend guidelines for lead in soil based on a critical selection of the best available scientific data and knowledge. Papers presented at this special conference have been published by the SEGH Journal "Environmental Geochemistry and Health" as a special proceedings entitled "Lead in Soil: Issues and Guidelines", edited by Davies and Wixson (1988).

In June 1988, a status report entitled "Lead in Soil: Issues and Guidelines Conference Summary" was presented by Wixson (1989) at the Trace Substances in Environmental Health Conference held in St Louis, Missouri. A special task force was then approved to study and report on lead in soil under the auspices of the SEGH.

The "Lead in Soil" task force is composed of SEGH members and represents a balance of established and reputable scientists from regulatory agencies, industries, the medical profession, public health authorities and universities: all are active workers in this subject. The SEGH task force has been supported by the U.S. Environmental Protection Agency (EPA), International

Lead Zinc Research Organization (ILZRO), the Lead Industries Association (LIA) and Clemson University. Its remit is to develop a report utilizing a flexible matrix approach or "phased action plan" to evaluate the evidence and problems in its interpretation and, hence, to make recommendations for guidelines to appraise lead concentrations in soil.

The SEGH task force has held meetings and developed a protocol which is supported by scientific documentation. A "phased-action plan" was coupled with target soil lead concentrations derived through a model relating blood lead and soil lead concentrations. Such a plan allows for the combined influences of soil and other sources of lead on blood. Thus the model offers flexibility for the user to select appropriate target levels of blood lead concentrations while allowing for a variety of environmental situations or regulatory criteria.

The report lists pertinent definitions and presents a logical and easy-to-follow management strategy in the "Phased-Action-Plan" which is then coupled with the derivation of the "Appropriate Target Soil Lead Criteria" necessary for the decision making process.

The rationale for the Phased Action Plan and selection of the appropriate target soil lead criteria are then further explained following the step-wise logic used in the management strategy. Detailed summaries of the scientific data used in the various steps of the protocol are then presented and cited with examples of standardized sampling procedures provided in the soil sampling supplement.

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The report then summarizes the protocol development and applications of the Phased Action Plan and Appropriate Target Blood-Lead Criteria with an extensive explanation and documentation of literature used to support the factors affecting health and contributing to the development of a model.

The question of bioavailability is considered followed by a section on risk assessment which goes into more specific details.

The support given by agencies, industries, the SEGH and external reviewers is acknowledged. References to documentation used in supporting the development of the recommended guidelines for lead in soil is noted followed by supplemental sections on soil sampling and risk assessment.

III. DEFINITIONS

Scientists use some words and terms in a very specialized and closely defined manner. Sometimes these words are used in everyday speech but with a wider or looser meaning. Also, words have been invented to provide for a specific communication need. The following glossary of such words is provided for the reader of this report.

BACKGROUND LEAD CONCENTRATION: the concentration of lead in soil at sufficient distances from known mobile or point sources of contamination such that it is representative of typical soils for the region in question.

BIOAVAILABILITY: for a given substance, different physical/chemical forms have different availabilities to, and therefore different effects upon, living organisms. Rarely is all the substance that is ingested or otherwise taken into an organism, absorbed by the organism. This means that a value for 'total' lead in a real environmental sample is almost always an overestimate of the amount of lead that is available and that will be absorbed. However, in the absence of reliable information concerning the form of lead in a sample, one should assume 100% availability. Moreover, at the present time only total lead can be determined accurately and precisely.

For scientific purposes, lead acetate, a water soluble lead salt, is used as the standard for 100% availability of dietary lead. When equal amounts of soil lead, or large particle lead sulphide, are added to the same test diet, the absorbed lead is lower than that of lead acetate, i.e., lower than 100%. This is

due to the physical and chemical properties of these lead sources. The standard diet for bioavailability is a casein-sucrose (AIN 78) purified diet, because high fibre or phytate in diets significantly lowers the fraction of dietary lead that is absorbed.

CONTAMINATION: Soils which are formed on similar parent materials and which have similar arrangements of horizons, i.e., they have formed under similar environmental conditions and are of similar age, are grouped together by pedologists in a soil "series." There is evidence to suggest that the trace element concentrations, including lead, for a large number of samples of a given soil series in the natural state can be described as having an upper and lower limit on the concentrations. The frequency distribution of lead values from a large number of samples is usually positively skewed but this skewness can be minimised, i.e. the population normalised, by transforming the values to their \log_{10} equivalents. The (geometric) mean value and the 95% or 99% probability ranges can then be calculated. Values for other samples apparently from the same series that do not lie within the range are described as anomalous and form a geochemical anomaly. If, from other evidence, it is deduced that the anomaly has been caused by anthropogenic activity, the geochemical anomaly becomes a neoanomaly and the soil is regarded as contaminated. Thus, a contaminated soil is one having a lead content larger than that expected from the pedological nature of the soil.

In practice, it may not be possible to identify a suite of uncontaminated soils. Statistical techniques exist for extracting the basal population. But this population is better described as 'background' rather than natural, uncontaminated.

DIRT: An ill-defined word which includes soil and dust and should not be used.

DUST: Loose mineral material lying as a thin veneer on a solid support. It is differentiated from soil in that soil is presumed to have formed from its rock base whereas dust has settled on the base. Dusts should be described as street, curb-side, settled-house or air-borne.

GARDENS OR YARDS: Excluding back-to-back terraced houses in industrial England most houses have associated with and adjacent to them a patch of open ground. In Great Britain part or all of this may be paved at the rear and is called the 'back yard' or when at the front, the 'forecourt'. Unpaved areas are used for growing grass (lawn), decorative plants or vegetables. All these unpaved areas are called 'garden'. In North America open areas are generally described as 'yard' and 'garden' will ordinarily imply a vegetable or flower plot.

LITTER: grass, dead leaves, decaying leaves, on the surface of a yard (garden) soil.

NEIGHBOURHOOD: a group of homes having similar external appearances and normally residents with similar socio-economic status, extending over an area of 16 - 25 square blocks (0.5 - 1 square mile), or equivalent to a US census tract.

PICA: An abnormal craving for certain unnatural foods such as clay, chalf, soil, paint chips or other materials.

POLLUTION: A term which has been expressed in many different ways. Wanielsta, et. al. (1984) have described pollution as "that which modifies the environment such that its use is affected." Warren (1971) devotes a chapter in his book for a discussion on pollution as a word that has social significance and is much used by individuals or groups to take on different meanings or stimulate legislation or appear in laws.

The report by the National Research Council Committee on Pollution (1966) starts off with "Pollution is an undesirable change in the physical, chemical, or biological characteristics of our air, land, and water that may or will harmfully affect human life or that of other desirable species, our industrial processes, living conditions, and cultural assets, or that may or will waste or deteriorate our raw material resources".

This means that a soil may be described as contaminated yet the concentration of lead in that soil may not be large enough to cause any deleterious biological effects. But where the lead or concentration does rise to a value where a specific organism is adversely affected then the soil may be described as polluted. Since pollution is an anthropogenic process then a soil should not be described as polluted where the lead content has reached injurious levels through natural processes.

Based on these various explanations and adapting soil from the water usage terms of Warren (1971), this report should simplistically define soil pollution as "any impairment of the

suitability of soil for any of its actual or beneficial uses, by man-caused changes."

PROPERTY: In North America the word is used generally to describe the plot of land upon which a building is situated and belonging to that building through freehold or leasehold. The term is in use in Great Britain, but less widely, and may be restricted to the building.

QUALITY ASSESSMENT (QAS): the overall system of activities to provide assurance that the quality control task is being performed effectively. Quality assessment involves a continuing evaluation of performance of the production system and the products produced.

QUALITY ASSURANCE (QA): a system of activities, the purpose of which is to provide the producers and users of a product or service with the assurance that it meets defined standards of quality with a stated level of confidence. The QA system includes the separate but coordinated activities of Quality control and Quality assessment.

QUALITY CONTROL (QC): the overall system of activities designed to control the quality of a product or service so that it meets the needs of users.

SCHOOL YARD: the area adjacent to a school where children play.

SOIL: The loose and weathered veneer of material overlying and merging with rock. Agronomists restrict the meaning of soil to the weathered material in which plants grow and distinguish 'pedogenetic' processes from geological weathering. Engineers

extend the term to all loose surface materials. The agronomic usage is adopted here.

Yard or Garden Soil: The soil found in gardens or yards. Surface soil is the top 2-6 inches (5-15cm) which contains the roots of most garden plants, while subsurface soil lies below 6" or 15cm. Litter includes grass, leaves etc. lying on the soil. Any surface litter accumulation is regarded as 'above surface material'.

Subsurface Yard or Garden Soil: The soil located in yards (gardens) at a depth of 2 - 6 inches below the litter level.

TRIGGER VALUE: the term used by the British Department of the Environment (Simms and Beckett, 1986) for concentration of lead in soil which, for the particular area and set of conditions under consideration, indicates the need to evaluate the risk to human health from the soil lead and, if necessary, leads to some kind of remedial action on or limitation of use of the land. There is no absolute value of lead in soil that can be used as a trigger.

IV. PHASED ACTION PLAN

This chapter is concerned with the flow diagram of the phased action plan, shown in Figure 1. The details of the several steps involved in interpreting the plan are discussed in the Soil Sampling and Environmental Aspects supplements at the end of the report. Discussion here is restricted to a concise description of each step as noted in the sequence A to S contained in Figure 1.

Step A: Unplanned Discovery of Elevated Soil Lead.

This step is primarily concerned with the evaluation of and action resulting from lead data derived from a systematic sampling of soil. However, an analysis for lead may be carried out on any sample of soil as a result of an individual's curiosity or suspicion. This is therefore termed an unplanned discovery. Unplanned discoveries may also emerge from soil surveys carried out for other purposes. The analytical value from such a process cannot be accepted uncritically; it should therefore be regarded as a crude value.

Step B: Unplanned Discovery of Elevated Blood Lead.

Concern about lead in soils and dusts might initially be raised as the result of the accidental discovery of one or more elevated blood lead values which might arise from clinical investigations in the area in question. Any elevated blood lead found in this way must be confirmed by repeat sampling and analysis and evaluated with respect to the health criteria adopted for the particular population.

There has been a trend to both lower blood lead values in the general population and to lower standards for acceptable blood lead concentrations, so that any criteria adopted at one time and place may not be suitable for all situations. The background information to be considered when adopting the health criteria are discussed in the health section of the report.

If the circumstances of the individual(s) tested suggest that soils and dusts could be a factor contributing to their unacceptable blood lead concentrations, then consideration should be given to proceeding to Box G for obtaining the first reliable soil lead values.

Step C: Unplanned Discovery of Elevated Lead in Other Media.

This is the discovery of elevated lead in animal or plant tissues, or some indication of a lead toxicity problem in livestock, domestic animals or wildlife, which imply the possibility that soil lead might be involved in the cause of the raised lead value.

Step D: Identification of a Potential Lead in Soil Problem.

Situations can sometimes be identified where there are reasons to suspect soil lead problems exist. The suspicion may arise from considering the history of land use (a smelter once stood there, perhaps) or from recognizing conditions of lead toxicity or excessive accumulation in biota. The further use of such land would lead immediately to a preliminary soil sampling (Box F).

Step E: Appropriate Target Soil Lead Criteria

Proposing a single value guideline for an upper concentration of lead in soil to protect young children was considered unrealistic for a number of reasons. Various blood lead concentrations are used as health standards around the world and these change as the health effects of lead are reinterpreted. The environment of the population at risk can vary widely. People may be exposed to lead in urban dusts derived from automotive emissions and leaded paints or to soil and dust contaminated by smelter emissions. Lead contamination is often widespread in old lead mining areas. Waste disposal sites can cause metal contamination locally. The population at risk can itself vary from situations where there is a high proportion of young children to a retirement home for the elderly.

Because of these considerations, the soil/dust 'guide line' is proposed as a relationship or formula. This allows adjustment for a variety of environmental situations and regulatory criteria. A number of recent papers have discussed modelling techniques applicable to multiple source exposure to lead and these are discussed in the Health section. Alternate models can of course be used within the framework of this document according to the data available and allowing for other priorities.

In the model we have developed, blood lead concentration is equated to a baseline level plus an increment resulting from exposure to soil or dust lead. The model takes account of the chosen blood lead guideline or target concentrations and the degree of protection required in the population. The slope of the blood lead - soil lead relationship used in calculating

increase in blood lead over a baseline value, and hence the soil guideline, can vary depending on a variety of factors. Thus, the response can be adjusted for a given situation and modified as more data become available.

The relationship derived is as follows:

$$S = \frac{\left[\frac{T}{G^n} - B \right]}{\delta} \cdot 1000$$

where:

S is the soil or dust guideline, a geometric mean concentration in μg Pb per gram of dust (i.e., ppm)

T is the blood lead guideline or target concentration, in μg Pb/dl whole blood

G is the geometric standard deviation of the blood lead distribution, typically in the range of 1.3 to 1.5

n is the number of standard deviations corresponding to the degree of protection required for the population at risk, and would normally follow from the way in which the blood lead guideline T was defined; e.g. that 95% of the population should have blood lead concentrations less than 20 $\mu\text{g}/\text{dl}$. Parameter n can be obtained from standard statistical tables, and some representative values are given below for different percentages of the population desired to be below the target blood lead concentration.

Percentage of Population < T_____	approximate value of n_____
50	0 (target is mean)
95	1.64
98	2.05
99	2.32
99.9	3.04

B is the background or baseline blood lead concentration in the population from sources other than soil and dust. Data from an appropriate control group would be ideal - a group matched not only for population characteristics, but also for similar lead exposure from all sources except soil and dust. If there are appreciable contributions from other sources such as smelter emissions or leaded paint, these must be measured or estimated for addition to the baseline value. If these data are not readily available, any proposed investigation should evaluate the contributions from other suspected sources.

δ (delta) is the slope or response of the blood lead - soil (dust) lead relationship and has the units of $\mu\text{g Pb/dl blood}$ increase per 1000 ppm increment of soil or dust lead.

Step F: Preliminary Soil Sampling and Analysis.

The procedure for making the first (the preliminary) systematic soil sampling and analysis for lead will follow a decision to proceed from an unplanned discovery (Boxes A, B and C in Figure 1), or from knowledge that there is already a potential soil lead problem (Box D).

If preliminary soil sampling is required, it is necessary to delimit the 'neighborhood' and design an appropriate sampling and analysis protocol (including appropriate quality control procedures).

To evaluate the extent of a possible soil lead problem, the preliminary sampling is designed to characterize typical soil lead levels in a neighborhood, rather than for individual houses, or particular spot locations around a house. The preliminary soil sample will normally be taken from the back of the house, generally in the center of the open space behind the built structure.

In the preliminary sampling and analysis, as at all stages of the investigation, it is necessary to take precautions against contamination or bias of samples, and to prescribe and adhere to stringent quality assurance (QA) and quality control (QC).

Step G: First Reliable Characterization of Soil Lead Values.

From the values that are obtained from the preliminary soil sampling and analysis, a relatively simple statistical treatment of the data will result in the characterization of the area in terms of the 'First reliable soil lead value'. This is the value that is used for the next level of decision making (Box H in Figure 1).

Step H: Potential Problem?

At this point, the value for soil lead is evaluated in terms of a 'trigger' value, and a second decision point is reached. There is no absolute trigger value, but the soil lead information which is now available in the investigation, and upon

which a decision can be made, is technically superior to that which was used to enter Box E. Based on the data obtained and the target levels chosen, the decision must be made either to end the investigation or to proceed to the risk assessment evaluation contained in the next step (Box I of Figure 1).

Step I: Evaluation of Community at Risk.

Evaluation is based on an exposure assessment and, in particular, the development of a relationship between blood lead concentrations and the contents of lead in soil where soil is considered to be one possible source of exposure.

The objective of this analysis is to propose a suggested guidance for the relationship between lead in soil and the results of blood lead levels. This relationship forms part of the exposure assessment. Other parts of the exposure assessment include contributions to blood lead from dust, water, food, paint and other sources.

Among the numerous technical and non-technical aspects that need to be considered are the number and age of the exposed population. If the area of concern contains children living in low income housing or areas frequented by children such as school yards or playgrounds, the pollution hazard is far more significant than if it contains commercial buildings such as factories or warehouses or if children are likely not to represent a significant proportion of the population, e.g., retirement communities.

The present and probable future land use needs to be considered in deciding whether and what kind of remedial effort

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is required. Overall risk assessment can be achieved on a site-specific or case-by-case basis. If the major exposure route is from the soil then the guidance suggested in this report may be used directly to determine clean up levels.

The nature of further sampling will depend upon the specific site and its set of conditions and, clearly, it may not be possible to sample all media. For example, in an area where development has not begun there will be no domestic plumbing from which drinking water supplies are derived and water analysis is not relevant. Nor can there be paint to scrape from existing structures. It may even be necessary to estimate the potential exposure to lead from other sources, since this stage leads to a risk analysis, for which other sources should be considered. Even though the purpose of the present procedure is to evaluate the impact of soil as a source of lead, judgment cannot be made without considering potentially confounding factors in as quantitative a manner as possible.

In contrast with the preliminary soil sampling (Box F), which is conducted without any measurement of the effect on the human population, this step will usually include a comprehensive sampling, including blood leads from most households that have children. It is therefore recommended that the appropriately comprehensive sampling of other media be carried out at the same time as the blood lead survey (if one is conducted). Soil, paint, dust and water should be sampled at every home that provides a blood sample. This avoids any nuisance that might arise from revisiting and intruding on the home. The decision can then be

made later whether or not to analyze all these other samples for lead.

For the detailed sampling, lead should be determined as follows:

1. Blood lead in children 1 - 5 years of age.
2. Soil lead for surface yard or garden samples- subsurface yard or garden samples
3. House dust.
4. Interior paint.
5. Drinking water.
6. Street dust.
7. Air.

The detailed procedures for sampling soil, dust, paint and air are described in the supplemental sections of the report. The purpose of this second level of sampling is to characterize the soil lead more accurately and in more detail, as well as to evaluate other sources of lead.

Step J: Design of Environmental Sampling

The U.S. Environmental Protection Agency has outlined a number of items which must be considered for inclusion in a QA project plan (U.S. Environmental Protection Agency, 1979). Those pertinent to the collection of data include: (a) project description, organization, and responsibility, (b) QA objectives for the measurement of data in terms of precision, accuracy, completeness, representativeness and comparability, (c) sampling procedures and custody, (d) calibration procedures and frequency, (e) analytical procedures, (f) data reduction, validation and

reporting, (g) internal and external quality control checks, (h) performance and systems audits, (i) specific routine procedures used to assess data precision, accuracy and completeness, (j) corrective action, (k) QA reports to management. A brief description of these items is summarized below and detailed. Additional information can be obtained from supplemental materials at the end of this report.

The environmental sampling program should provide a general description of the project including experimental design. It can be brief but should be sufficiently detailed to allow those responsible for reviewing and approving the program to complete their task. It should include a timetable for the initiation and completion of tasks within the program, a statement of the purpose for which the project is planned, and the intended use of the data. The plan should show project organization and line authority. Individuals responsible for ensuring the collection of valid data and the for assessment of measurement systems for their precision and accuracy should be identified. A person responsible for carrying out the provisions of the QA plan, a QA officer/manager, should be appointed and identified. All project personnel with responsibility for the quality of the data should receive a copy of the QA project plan and be aware of its contents.

Step K: Blood Survey.

Any detailed blood survey must take account of several important considerations before it is initiated. The health criteria against which the survey results are to be judged should

be agreed during the planning stages and procedures established for providing appropriate medical and environmental follow-up of any individuals whose blood lead content exceeds the projected guideline value. This would be necessary whatever the decision taken about any action concerning the area and population in question.

Blood samples should be taken by personnel properly trained to avoid sample contamination and using demonstrably low-lead materials. The blood should be analyzed only by a laboratory experienced in routine blood lead analysis and whose quality assurance program includes satisfactory performance in an external quality control scheme.

The individual results should be made available to the participants along with an interpretation of the survey findings. Any individuals suspected of being unduly affected must be referred to the appropriate physician or hospital for further investigations.

Step L: Soil Lead Survey.

For detailed soil sampling an extensive set of samples should be taken. These should represent the drip point of the overhang on each side of the house, the centroid of the front, if one exists, as well as a three point transect across the back yard (garden). In these cases, each sample will be analyzed separately rather than after bulking together. This will provide more detailed information on the extent, location and source of the contamination. It is probable because of the shedding of paint from buildings and impaction of lead aerosols on buildings, that

the absolute value of the samples taken from the sides of buildings will be higher than those collected in the preliminary soil sampling from the backyard.

For schoolyards, public playgrounds, parks or other amenity areas, the detailed soil sampling will utilize a grid sample in order to map the extent of the contamination. A sample should be taken from the intersection of each of the grid lines. For vacant and industrial areas or for agricultural land, the grid system should also be used. Again, the sample from each grid intersection must be analyzed separately although that sample may be made up of individual soil cores.

Detailed sampling programs containing illustrations on techniques, number and location of samples and other pertinent information are found in the supplemental section of the report.

Step M: Surveys of Lead in Dusts, Plants and Waters.

Sampling protocols for plant, dust, water and paint are covered in the supplemental materials on sampling.

Step N: Potential Problem?

Based on the evaluation of the information gained during the various steps of the risk assessment evaluation, the decision should be made either to end the investigation or to proceed to the Implementation Stage. This starts with Step O and is concerned with a second data evaluation.

Step O: Second Data Evaluation

Before deciding the nature and scope of any remedial action it is important to ascertain the availability of financial resources. Depending on the specific site location, size and

uses, the contaminated site may be eligible for public sector assistance (e.g., community, state and federal resources) which may supplement any private sector funds. Without this inventory of resource availability inadequate or inappropriate remedial actions may be proposed.

The costs involved with the physical cleanup of the soil are not always the only ones incurred during remedial actions. Legal liabilities may be created through either taking or not taking action. These play a significant role in determining the scope of the remedial action plan. The costs of monitoring a site after the cleanup has been completed should also be included when estimating the total cost of remedial action.

Step P: Necessary Actions

Based on the findings of the second data evaluation made in Step O, a risk assessment/management plan for the specific site needs to be considered. Factors involved in the risk management decision process include economic, legal, political and social aspects. The uncertainties and non-technical issues concerned with the risk assessment and management are presented in the supplemental materials at the end of the report.

Step O: Remedial Actions

If the risk assessment/management plan prescribes remedial actions then a number of issues must be considered. These include economic and financial considerations, legal and liabilities involved in taking or not taking action; various types of soil treatment to reduce potential health risks, community education and behavior modification. More specific

information on these issues and recommendations for cost effective methods are contained in the section on risk management and remedial actions.

Step R: Report Archival

All data collected and evaluations made throughout the various steps of the phased action plan for lead in soil need to be retained in an appropriate public domain archive (e.g., the appropriate agency office designated by federal or state law in the USA or more generally in a library or computer data base). The reports should be available for review or use if there is a change in the usage of a specific site or the population at risk.

If for any reason it becomes necessary to continue additional evaluations of a site then the data collected, evaluated and decisions reached earlier will serve as a base for the later assessments with a consequent saving in time and money. It is therefore imperative that good records be maintained for possible future use.

Step S: Situation Monitoring

After remedial action has been completed, the site must be monitored by a purposeful plan to ensure that the cleanup actions remain effective. The scale, duration, cost of monitoring and record keeping depends on the type of action taken and should be included in the project budget. Finally, after a further passage of time, the action should again be evaluated and recorded for future reference.

V. HEALTH

In this section the factors concerned with lead and health are discussed in terms of the population groups at risk and in terms of adverse health effects of lead. The resulting health criteria are then used to derive a target soil or dust lead guideline concentration.

A. Population Groups at Risk for Adverse Health Effects of Lead.

Exposure to lead and its adverse health effects have been intensively studied, particularly during the past 15 years. These studies, which have been reviewed and critically evaluated in the Air Quality Criteria for Lead (US EPA, 1986), have identified the fetus and young child as the population groups at greatest risk for adverse health effects of lead. Because lead freely crosses the placenta, women of childbearing age, as surrogates for the fetus, are also identified as a high risk population group. In addition, analyses of the NHANES-II data (Mahaffey et al, 1982) suggest that: 1) modest increase in blood lead concentration (PbB) in middle-aged white males may be associated with a very small but statistically significant increase in blood pressure and, 2) may be associated with a 25% increase in PbB in post-menopausal women. One should note the data suggest that in post-menopausal women the effect is greatest in nulliparous women and least in multiparous women. These latter groups are not considered at risk for over exposure to lead in soil.

1. Fetus.

Paul (1860) was the first to report an increased incidence of spontaneous abortion and stillbirth in pregnant women with clinical manifestations of severe lead poisoning. This observation was confirmed by others during the next 50 years and led to the recommendation that women be excluded from the lead trades, a recommendation that has been accepted in many countries. Tissue analysis of the products of conception (Barltrop, 1969) reveal that lead freely crosses the placenta and accumulates in the tissues of the fetus at a high rate during the third trimester of pregnancy. The concentrations of Pb in the various tissues of full term stillbirths were found to be equivalent to those reported in non pregnant adult females (Barry, 1975). A number of studies have shown that maternal PbB and infant cord PbB are essentially equivalent at birth.

A number of prospective studies on lead absorption and its health effects are now in progress in the United States, the United Kingdom, Australia, Yugoslavia, and Mexico. In these studies women are enrolled during pregnancy and their offspring are to be followed longitudinally at least until school age. These studies are notable for the numerous covariates and potentially confounding variables that have been taken into account in the analyses of the data. The studies in Boston and Cincinnati in the United States and in Port Pirie, South Australia, are the most advanced at the present time. The findings, summarised by Davis and Svendsgaard (1987), show a significant reduction in gestational age that is inversely related to cord or maternal PbB levels. This has been a

consistent finding in most of the studies. Some, but not all, studies have shown a reduction in birth weight at blood lead levels greater than 12-13 $\mu\text{g}/\text{dl}$.

The Boston study (Bellinger et al, 1987) is concerned primarily with prenatal exposure to lead, inasmuch as average PbB postnatally in this upper middle class cohort of infants was 5-7 μg Pb/dl. At birth, however, these investigators divided infants into 3 prenatal lead exposure groups: low (PbB 0-3 $\mu\text{g}/\text{dl}$); mid (PbB 5-8 μg Pb/dl); and high (PbB 10-18 μg Pb/dl). These investigators have reported that infants born with PbB greater than 10 $\mu\text{g}/\text{dl}$ show impaired mental development at least until 2 years of age (as indicated by the Bayley Mental Developmental Index). After correction for covariates and confounders, mean IQ differed by 7 points between the low and high cord blood lead groups.

2. Child: Birth to 6 or 7 Years.

Byers and Lord (1943) were the first to report that clinically acute lead poisoning during early childhood had lasting neurotoxic sequelae. Nineteen of the twenty children whom they followed through the early school years were excluded from school. They attributed this primarily to anti-social behavioural disorders, short attention span and sensorimotor deficits. They remarked upon the fact that these children failed in school despite the fact that they had apparently normal intelligence quotients (IQ) as judged by global intelligence test scores. By the early 1970s (Lin-Fu, 1973), emphasis began to change from treatment to prevention and to the study of the

effects of low level lead exposure in asymptomatic children. The work of Needleman et al (1979) found, in a general population cross-sectional study of first and second grade school children, a significant 4 point reduction in verbal IQ, shortened attention span and a dose related increase in the frequency of unfavorable classroom behaviors. A recent follow-up evaluation of this cohort (Needleman et al, 1990) suggests that these early developmental effects are reflected in later high school performance and academic success. A number of other cross-sectional studies have been reported since 1979, and are reviewed in detail elsewhere (US EPA, 1986; Smith, Grant and Sors, 1989). Some have confirmed the findings of Needleman and his group, while others have failed to find statistically significant differences. A number of the studies, including those of Needleman, have been criticized on the basis that the number of subjects in each group were too small to achieve adequate statistical power or that the studies failed to control for important confounding factors.

The limitations of cross-sectional studies have led to the several prospective longitudinal studies now in progress. It should first be noted that the lead exposures as indexed by PbB levels have decreased substantially during the past 30 to 40 years, particularly during the past decade. Thus, the current, ongoing prospective studies are being carried out with children with substantially lower PbB's than those encountered in the United States in the general population during the 1970's. The reductions in exposure to lead appear primarily due to reductions

of lead in food, water, and air. The prospective Boston study, (Bellinger et al, 1989) has dealt primarily with prenatal exposure to lead while the other prospective studies have dealt with a combination of elevated pre and post natal exposure to lead. The Port Pirie study (the most advanced of these prospective studies), indicates that intelligence as measured at four years of age is inversely related to the integrated PbB concentration up to 3 years of age (McMichael et al, 1988). As integrated lifetime average PbB increased from 10 to 31 $\mu\text{g Pb/dl}$, the general cognitive index decreased by 15 points, 7.2 points of which were attributable to lead after correction for covariates and confounders.

While most of the prospective studies are reporting some lead-related developmental effects, the nature of the insults, and the exposure patterns with which they are associated, are not consistent across the studies. Furthermore, much remains to be learned regarding the relative importance of prenatal and postnatal exposure, the persistence of the effects and their long term impact on social and academic competency. The prospective studies are extensively reviewed elsewhere (US EPA, 1986; Davis and Svendsgaard, 1987; Smith, Grant, and Sors, 1989).

3. Organ Sensitivity.

The primary target organs for lead are the central and peripheral nervous system, the hematopoietic system and the kidney (US EPA, 1986). Effects on other organ systems have been reported, but occur only at very high levels of exposure. Lead has been shown to inhibit heme synthesis in every organ in which

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the question has been studied. Furthermore, each cell synthesises its own hemoproteins. The principal enzymes affected are porphobilinogen synthase (PBGs), formally known as delta-aminolevulinic acid dehydrase (ALAD) and ferrochelatase. These partial inhibitions are associated with a pathognomonic constellation of biochemical changes, including in vitro inhibition of PBGS activity in peripheral blood, increased zinc protoporphyrin in erythrocytes and increased outputs of delta-aminolevulinic acid (ALA) and coproporphyrin in urine in association with normal or slightly elevated outputs of porphobilinogen and uroporphyrin in urine. While the PbB threshold for inhibition of PBGS activity in vitro lies at a PbB of 5-10 μg Pb/dl or less (Chisolm et al, 1985), the blood lead threshold for increasing zinc protoporphyrin is at 15-18 μg Pb/dl (Piomelli et al, 1982; Hammond et al, 1985). The effects of lead on the biosynthesis of heme are reversible, including lead-induced anemia. Inhibition of heme synthesis in the developing erythrocyte in the bone marrow was identified as the critical or most sensitive adverse affect of lead (Nordberg, 1976). This established the scientific basis for the use of micro erythrocyte protoporphyrin tests for screening purposes. It should be noted that erythrocyte protoporphyrin levels are also increased in iron deficiency states. In the light of more recent data on the neurotoxic effects of lead, it would appear that the developing nervous system is at least as sensitive, if not more sensitive to lead, than heme synthesis in the bone marrow, an effect which is reversible. Furthermore, experimental

data and studies in man strongly suggest that the neurotoxic effects of lead are not reversible. Various other metabolic and neurotoxic effects of lead as studied in experimental animals and man are beyond the scope of this text but are reviewed extensively elsewhere (US EPA, 1986).

4. Endogenous Factors Affecting the Susceptibility of the Fetus and Young Child to Lead.

Factors which render the fetus and young child more sensitive to lead than older children and adults relate primarily to the very rapid growth rate during this early period. Indeed, the nervous system has a growth rate more rapid than other tissues during the latter part of fetal development and early postnatal life up to about 6 years of age. The brain in infant experimental animals tends to accumulate and retain lead long after dosing with lead is stopped, a phenomenon not observed in mature animals. It has also been shown (Ziegler et al, 1978) that human infants from birth to 2 years of age absorb approximately 50% of dietary lead, one half of which is retained. By contrast, adults absorb 8-12% of dietary lead, only a very small fraction of which is retained. Indeed, the data of Ziegler et al (1978) indicate that an infant is in positive lead balance when the dietary intake of lead exceeds 5 μg Pb/kg body weight/day. Studies in human adult volunteers indicate that the absorption of lead is increased by a factor of 3 to 5 when administered in the fasting state. It should further be noted that infants receive a diet composed primarily of milk. In experimental animals milk has been shown to increase the

absorption of lead. Cow's milk, unless fortified, is also deficient in iron and copper. The bioavailability of zinc may also be reduced in cow's milk. The experimental data in animals indicate that deficiencies of these elements enhance the absorption and retention of lead (Mahaffey, 1981). The demands of growth render infants and toddlers highly susceptible to nutritional deficiencies. In summary, very rapid growth rate, particularly of the neural system, and the high rate of intestinal absorption and retention of lead are the principal factors which make the fetus and young child the population group at highest risk for over exposure to lead and its adverse health effects.

B. Populations at Risk for Exposure to Lead in Soil

Infants and children, from birth to 6 or 7 years of age, constitute the group at greatest risk for exposure to lead in soil. Within this overall age range, children may be divided into two age groups; namely, 6-36 months of age and 37-72 months of age, based primarily upon developmental and behavioural considerations. Even so, it should not be forgotten that studies among older children living in proximity to stationary point sources of lead emissions, such as smelters, have also shown increases in PbB although the degree of increase has not been as great as it is in younger children similarly exposed (Landrigan et al, 1975; Yankel et al, 1977; Roels et al, 1980). The hand to mouth route of lead in soils and interior household dust has been well documented as a major pathway of environmental lead into the

bodies of young children (Sayre et al, 1974; Roels et al, 1980; Bornschein et al, 1987).

1. Children 6-36 Months of Age.

Until approximately 6 months of age, infants tend to spend virtually all of their time in cribs (cots). Between 6 and 12 months of age, infants begin to scoot, crawl and walk, thereby enabling them to move freely about the home during which time they become more highly exposed to lead in interior household dust. A portion of this dust represents lead in exterior soil tracked into the home, as well as that which may be blown in through open windows and doors. During this age period, infants and toddlers tend to spend 80-90% of their time indoors.

The most important factor is the prevalence of hand to mouth activity as a normal developmental component of behaviour in this age range. Virtually all children suck their thumbs and fingers during their first year of life. Sucking fingers occurs as a result of the sucking reflex. Barltrop (1966) noted its occurrence at 12 months of age in 80% of children studied, as determined on the basis of 24 hours and 14 days recall by parents. After 12 months of age, thumb sucking and finger sucking tend to taper off slowly over the next five years, at the end of which, perhaps, only 20-30% of children are reported to show this activity. Between 12 and 72 months of age, thumb sucking generally occurs in relation to fatigue, boredom, illness, punishment and other frustrating situations to which the child responds by regressing to a more infantile type of behaviour. After 5-6 years of age, finger sucking should be

considered as evidence of emotional immaturity (Harper and Richmond, 1977). Among older children, particularly males, playing in the dirt and a disregard for cleanliness go hand in hand. Thus, exposure to lead in soil can persist well into the school years. Indeed, the study of Roels et al (1980) was based primarily on older school-aged children and environmental data obtained by measuring lead in soil in school yards.

It is normal for a child to mouth foreign objects during infancy. If they ingest non-food items such as any item from the floor, dirt, plaster, wood, sand etc., the habit may be defined as "pica". During infancy, this represents oral exploration of the environment. Why children exhibit this habit is unknown, although dietary deficiency of iron has been proposed, but not substantiated. Lourie (1963) considered the "absence of mothering" as an important factor in the etiology of pica. "Absence of mothering" might be due to the fact that the mother was out at work, preoccupied with younger infants, mentally disturbed or an abuser of alcohol or other drugs. In the study of Barltrop (1966) pica or ingestion of non-food substances was observed to occur at about one-half the frequency of mouthing during the age period from 12-72 months. Some mentally deficient children may persist in the habit of pica throughout childhood and well into the adult years. In more recent studies on lead exposure in preschool age children the Caldwell HOME inventory has been used to assess the role of caregiving in the home on mental development. Several investigators have found that 3 subscales of the HOME in particular (Maternal Involvement with

Child, Provision of Appropriate Play Material, and Emotional and Verbal Responsivity of Mother) were negatively correlated with cumulative lead as indexed by serial PbB measurements. It was noted that even within the same socio-economic class wide variation in the quality of caregiving was found. These findings suggest that infants and toddlers receiving inadequate social and physical stimulation may indulge in greater amounts of hand to mouth activity than those similarly exposed to lead in dust and soil but for whom the quality of caregiving was higher (Schroeder, 1989). General cleanliness of the home also has been shown to influence PbB levels in children (Yankel et al, 1977).

2. Children 37-72 Months of Age

Between 3 and 6 years of age, the habits noted above persist but decrease in prevalence and frequency. Also, growth rate has decreased substantially. Conversely, children in this age range will tend to spend more time outdoors where they can be exposed directly to lead in soil in their play areas, particularly if their play areas are bare soil.

C. Definitions of Acceptable Blood Lead Concentrations.

Measurement of the concentration of lead in whole blood provides an indicator of the internal dose of lead and has served in epidemiological surveys as the most widely used indicator of lead absorption for the past 20 to 30 years. The total amount of lead in whole blood at any point in time is the sum of both recently absorbed lead and lead absorbed in the past. For example, an isolated brief episode of sharply increased lead absorption will sharply elevate blood lead concentration for a short period of time. Lead is stored primarily in bone from which it is slowly recycled back to the blood over a long period of time. Despite these shortcomings, it remains the most useful index of lead exposure and absorption for the purposes of epidemiological surveys.

Lead can and has been measured in urine and hair. There may be wide variation in concentration of lead in urine so that urine lead measurements are not useful for epidemiological surveys. Lead may be adsorbed on hair so that a hair lead measurement does not necessarily represent what has been absorbed into the body and incorporated into the hair. This measurement is considered of no use for epidemiological purposes. The use of the calcium disodium EDTA mobilisation test for lead has been largely limited to clinical research. Furthermore, this test may not be without hazard inasmuch as experimental studies indicate that a single dose may elevate the concentration of lead in brain and liver (Cory-Slechta et al, 1987). Newer techniques for the measurement

of lead in bone as well as the measurement of lead in shed deciduous teeth still fall within the realm of research.

The erythrocyte protoporphyrin (EP)* test is widely used in screening for increased lead absorption and toxicity in the United States. "Free" erythrocyte protoporphyrin (FEP) is also elevated in iron deficiency so that the test is not specific for lead. Serial measurements of lead and FEP over time are useful in following trends in lead absorption.

All the clinical data on the effects of lead on early neurodevelopment have used either blood lead concentration or the concentration of lead in shed deciduous teeth as the index of the lead dose. Although the need for a soil lead survey may initially be triggered by an isolated measurement of lead in hair, an elevated FEP test or other test, no decision regarding a soil lead survey should be made until blood lead data are available.

*Footnote

With few exceptions, 95% or more of the porphyrin in circulating erythrocytes is zinc protoporphyrin (ZnPP). Sometimes ZnPP is measured directly usually as $\mu\text{g/dl}$ of whole blood. Sometimes in certain extraction procedures zinc is removed and the term "free" erythrocyte protoporphyrin (FEP) is used. FEP is usually reported as $\mu\text{g/dl}$ of erythrocytes (FEP) or $\mu\text{g/dl}$ of whole blood (EP). All three give the same information, but values differ according to whether the concentration is expressed in terms of whole blood or erythrocytes or as a ZnPP/haemoglobin ratio.

1. Historical Lowering of Acceptable Blood Lead Concentration.

Historically, acceptable blood lead concentration has been defined as that concentration below which adverse health effects, as understood at that time, were not likely to occur. The development of the colorimetric dithizone technique for measuring of lead in biological tissues and fluids, including blood, made blood lead measurements feasible for the first time on a reasonably wide scale. The "dithizone era" lasted from the early 1930s until about 1970 when it was replaced by atomic absorption spectrophotometry (AAS) and anodic stripping voltammetry (ASV). Micro AAS methods are the most widely used ones today.

The dithizone method was cumbersome, difficult, and most laboratories required 10-20 ml of blood for a single analysis. By contrast, modern ASV techniques require only 100 microliters of blood and micro AAS methods require far less. Furthermore, it is now possible to use samples in which lead has been determined by isotope dilution-mass spectroscopy (ID-MS), the ultimate reference method for lead, and for primary standardization of alternate techniques. Furthermore, quality assurance and quality control methods have become highly developed during the past 15 to 20 years which gives greater assurance of accurate results.

Given the large amount of blood required during the dithizone era, it is not surprising that blood specimens were not usually taken unless there was strong clinical suspicion that the patient had lead poisoning. Furthermore, medical interest was concerned primarily with acute clinical disease.

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Papers published in the literature up until about 1970 dealt primarily with the diagnosis, treatment, and sequelae of acute clinical lead poisoning. Thus the upper limit of acceptable blood lead concentration in adults until about 1970 was 80 μg Pb/dl whole blood. This limit was chosen because acute lead colic was almost never encountered at lower concentrations. In children, up until 1960-1965 the upper limit of acceptable blood lead concentration was 50-60 μg Pb/dl whole blood. This was based largely on the observation that one did not encounter bands of increased density on x-ray at the growing ends of the long bones (the so called "lead line") at lower blood lead concentrations while early nonspecific clinical manifestation such as irritability and anorexia might be encountered above this level. Indeed during this era, due to the lack of availability of blood lead measurements, the diagnosis of lead poisoning in children was often based on X-ray findings and the presence of basophilic stippling of erythrocytes, both rather insensitive indices of lead absorption.

It has long been known that lead disturbs heme synthesis as manifested by increased concentration of protoporphyrin in circulating red blood cells and increased output of coproporphyrin and delta-aminolevulinic acid in urine. Reliable quantitative techniques for coproporphyrin and delta-aminolevulinic acid in urine were developed in the 1950s and used rather widely in the 1960s in studies to determine the dose-response and dose-effect relationships for these metabolic evidences of toxicity due to lead. It became apparent that the blood lead

threshold for these responses in both children and adults was at a PbB level of approximately 40 μg Pb/dl of whole blood (NAS/NRC, 1972). At the same time, studies in children without exposure to lead beyond that found in usual food, water and air at the time did not exhibit PbB in excess of 40 μg Pb/dl whole blood. In 1970, the Surgeon General of the United States proposed 40 μg Pb/dl whole blood as the upper limit of normal or acceptable blood lead concentration (US Dept. Health, Education and Welfare, 1971).

By the late 1960s it became apparent that chelation therapy, although effective in reducing mortality from acute lead encephalopathy, did not result in any dramatic reduction in the occurrence of permanent CNS sequelae in children with recurrent episodes of clinical lead poisoning. Interest, therefore, shifted, together with an awakening of social consciousness in the mid 1960s, from case finding and treatment to prevention of lead toxicity. The critical effect concept, as fully described in the report of the Subcommittee on the Toxicology of Metals of the Permanent Commission and International Association of Occupational Health, provided the scientific rationale and practical approach for the prevention of lead toxicity (Nordberg, 1976). Under this concept, if the "critical" or earliest measurable adverse health effect can be identified and effective action is undertaken on this basis, then later and more serious effects can be prevented. Disturbance of heme synthesis in the bone marrow was identified in this report as a critical effect of lead. At the time, the most sensitive measure reported was in

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vitro inhibition of the activity of delta-aminolevulinic acid dehydrase in circulating red blood cells. However, the significance for health of this in vitro measure was uncertain.

At about the same time, micro methods for the measurement of zinc protoporphyrin in circulating erythrocytes either as zinc protoporphyrin or as "free" erythrocyte protoporphyrin became available for screening purposes. The blood lead threshold for the earliest increase in erythrocyte protoporphyrin is in the range of 15-18 $\mu\text{g Pb/dl}$ whole blood (Piomelli et al, 1982; Hammond et al, 1985). In 1978, the US Centers for Disease Control recommended that the upper limit of acceptable blood lead concentration be lowered from 40 to 30 $\mu\text{g Pb/dl}$ whole blood. The nature of the dose response curve for the relationship between blood lead and FEP is such that many children with blood lead concentrations even greater than 30 $\mu\text{g Pb}$ will be missed on the basis of an FEP screening test. In short, the test does not have high sensitivity and specificity for lead at blood lead levels below 50 $\mu\text{g Pb/dl}$ whole blood.

2. Current Reference Values.

It is clear that blood lead concentrations in the general population had been declining for at least 20 to 30 years in the U.S. and the U.K. The data prior to 1970 are based upon the use of the dithizone method, so that some of the decline may be attributable to differences in methodology. However, this does not appear to be true during the atomic absorption era as there have been no significant changes in methodology over the past 15 years or so. In the United Kingdom (U.K.), it is estimated that

blood lead concentrations have been decreasing by 4-5% per year during the past decade (Quinn and Delves, 1989). During 1986 the geometric mean PbB in children and women in the U.K. was approximately 8 µg Pb/dl whole blood. Decline in PbB in the United States has been greatest during the past decade. The NHANES-II data indicate that between 1978 and 1980 mean PbB in the United States decreased from 15.9 to 9.6 µg Pb/dl of whole blood (Annest et al, 1983). It is currently estimated that mean PbB may be approximately 6 µg Pb/dl whole blood in unexposed populations in the United States (ATSDR, 1988). In the United States this decline has been attributed to sharp reductions in both air and food lead.

At the present time the World Health Organization (WHO) recommendation for acceptable blood lead concentration is no more than 2% of the population with a PbB greater than 20 µg Pb/dl of whole blood. The latest recommendation (1985) of the U.S. Centers for Disease Control in the United States is that the upper limit of acceptable PbB should be 24 µg Pb/dl whole blood. These values are comparable and suggest that the geometric mean PbB should be equivalent to 10 µg Pb/dl of whole blood or less. In the U.K. and U.S. it is recommended that any child found with a PbB equal to or greater than 25 µg Pb/dl of whole blood be investigated for the purpose of reducing that individual's exposure to lead.

3. Current Research Findings.

The most recently available studies on the neurobehavioral effects of lead during fetal life and early childhood as

summarized by Smith et al (1989) strongly suggest that the upper limit of acceptable blood lead concentration should be reconsidered and probably lowered. It now appears that the developing nervous system is at least as sensitive to lead if not more sensitive than disruption of heme synthesis in the bone marrow. It is known that both the United States Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC) are seriously considering lowering the upper limit of acceptable blood lead concentration. Current research results, primarily from the prospective studies on the neurobehavioral effects of lead during early development, would suggest that these limits may be lowered to perhaps 10 μg Pb/dl of whole blood in pregnant women and to perhaps 15 μg Pb/dl of whole blood in children.

In summary, the limits of acceptable PbB have changed substantially during the past 50 years. During each decade such limits were generally set on the basis of what was perceived at the time to be a significant adverse health effect. Initially, the aim was the prevention of acute clinical disease. The limits have also changed in relation to improving technology which has permitted the measurement of lead and its various adverse health effects at lower and lower levels as the sophistication of technology advanced. Thus, during this fifty year period one has seen a lowering of the upper limit of acceptable blood lead concentration in children from 60 μg Pb to 20-24 μg Pb/dl whole blood. It would not be surprising if this limit were further lowered during the next several years to 15 μg Pb/dl of whole blood or possibly lower in pregnant women.

D. Other Sources of Lead

For purposes of classification, environmental sources of lead may be divided into three groups according to the concentrations of lead likely to be found in each of the sources: a) low (or baseline) dose; b) intermediate dose; and c) high dose. In general, intermediate dose lead sources are associated with moderate increases in PbB in children up to 50-60 $\mu\text{g Pb/dl}$. Such children are asymptomatic. High dose sources, while often associated with similar increases in PbB, are also associated with much higher PbB levels (greater than 80-100 $\mu\text{g Pb/dl}$). In the latter group, acute clinical symptoms are likely to be found. Fatalities have also been reported in relation to some high dose sources. For a particular source the range of PbB levels found in groups of children that have been studied may span across all three classification groups. For example, the amount of lead bearing particulates borne from workplace to home on the clothing of workers may vary widely so that some children are symptomatic while others show little effect (Baker et al, 1977).

1. Low (baseline) Dose Sources.

The general population is exposed to small amounts of lead in air, food and water. Lead in air and food have decreased dramatically in the 1980s in the United States (US EPA, 1986; ATSDR, 1988). The concentration of lead in drinking water varies widely around the world and appears to depend primarily upon the presence of lead in pipes and solder in the distribution system in areas of the world where the water is soft with an acidic pH. Such waters are generally described as "plumbosolvent" and

"aggressive". This phenomenon has been intensively studied in northern England and Scotland (Moore et al, 1985). When discovered, such water supplies can be treated to reduce the plumbosolvency of the water.

2. Intermediate Dose Sources.

Sources in this group are generally those which contribute to the lead content of interior household dust and in some circumstances children's play areas. Included in this group are lead-bearing particulates brought into the home on the dirty work clothing of lead workers (Baker et al, 1977; Chisolm, 1978). Removal of lead paint, particularly if flame gas torches, heat guns and mechanical sanders are used, can greatly and acutely increase interior and exterior lead bearing particulates and has been associated with clinical illness in both workers and exposed children (Feldman, 1978; Farfel and Chisolm, 1987). Similar increases occur when amateurs and residents carry out these procedures unaware of the hazards involved (Fischbein et al, 1981; Inskip and Atterbury, 1983). Even in the absence of paint removal work, interior household dust lead tends to be higher in older housing due to the weathering and chalking of old lead based paints. Cottage industry and hobbies involving the making of pottery, other ceramic ware and art glasswork can lead to rather high concentrations of particulate lead in the household dust particularly in the areas of the home in which these activities are carried out.

The fallout from primary or secondary smelter emissions can heavily contaminate the local area. In some areas the water lead

levels may be particularly high and may be associated with moderate increases in blood lead concentration. When these situations are investigated, the range in PbB concentrations found may be quite wide and include some individuals with blood lead concentrations high enough to be compatible with early clinical lead poisoning.

3. Specific and Unusual High Dose Sources.

This group includes sources in which lead is more concentrated and with which cases of clinical lead poisoning, including fatalities, have been identified. Indeed, a number of the unusual sources have only come to light following the study of individuals with severe acute clinical plumbism. Within this group, the ingestion of lead based household paint is clearly the main source of serious lead poisoning in children, particularly those with pica. Such paints may contain 1-70% lead so that tiny bits contain a highly toxic dose of lead. For example, a paint flake weighing 10 mg (about the size of a matchhead) containing 10% lead (1000 micrograms) if eaten repeatedly can over the course of a few months lead to serious clinical disease. In the United States it is estimated that 52% of the current housing stock contains lead pigment paints on exposed residential surfaces (ATSDR, 1988). Paint in defective condition constitutes an immediate and serious hazard.

Acidic beverages such as fruit juices, cola drinks, coffee and wine can leach substantial quantities of lead from improperly lead glazed ceramic ware. Children have swallowed items made of lead such as curtain weights, fishing weights, shot, jewelry

coated with lead to simulate pearl, and jewelry with a lead base. If these items remain in the stomach the lead will be slowly dissolved. The severity of the case will depend on how long the item remains in the stomach. The use of lead contaminated health foods (usually calcium supplements) has also led to serious disease as has the use of herbal medicines from China, other parts of Asia and Mexico. Water stored in lead-lined cisterns on rooftops, and rain barrels used as a source of drinking water in close proximity to lead emitting plants such as primary or secondary smelters can produce severe disease as has the burning of battery casings in the home for heat and the preparation of food. Sniffing of leaded gasoline has produced lead encephalopathy (Chisolm and Barltrop, 1979; Chisolm, 1985).

E. Evaluation of Data From Survey by Follow up on Case Studies.

In any survey situation it is likely that more than one source of lead will be found in a given child's environment. It is rare to find a group in which soil is the only significant source of overexposure to lead. Those who conduct surveys have an ethical responsibility to see that the subjects receive appropriate medical and environmental follow-up. While this need not be done by the survey group it is still the survey group's responsibility to refer affected individuals to an appropriate facility. Analysis of the data from the survey may indicate that there is no significant over exposure to lead in soil. On the other hand, PbBs may be log normally distributed and significantly related to lead in soil which in turn would suggest

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that lead in soil is the major source of environmental lead for the group. If the distribution of PbBs is greater than the range of PbBs acceptable in a given community a decision may be made to reduce overexposure to lead in soil. When this is done, there is a further obligation to do a follow-up survey including follow-up PbB measurements to evaluate the effectiveness of the steps undertaken under that decision.

The children who have participated in the study should also be evaluated as individuals. As a general rule, human research may only be carried out after approval of the appropriate human research committees. Ethical considerations require that research involving children may be conducted only if it is potentially beneficial to children. For this reason, data for each child must be evaluated on an individual basis not only for exposure to lead in soil but also to one or more additional sources of lead. Review of the questionnaire should help to identify other sources such as lead bearing particulates borne into the home on the clothing of lead workers, cottage industry or home hobbies, lead contaminated water supply or defective lead based paint. Ethnic groups known to use herbal medicines and/or lead bearing cosmetics require evaluation from this point of view. Blood lead values well beyond the log normal distribution of blood leads in the group (statistical outliers) suggest either severe pica with or without mental retardation or one of the high dose other sources previously cited.

Nutritional status of the group is likely to be ascertained to some extent in the questionnaire. For example, FEP values

significantly higher than that expected for a given PbB value strongly suggest iron deficiency usually due either to inadequate nutritional intake or chronic blood loss. In any event, all children who show either PbB or FEP levels beyond the acceptable limit should be referred for a complete medical workup and therapeutic intervention if that is deemed appropriate. The basic aims of intervention are usually to improve nutrition and reduce exposure. Steps needed to reduce exposure will need to be fitted to individual circumstances. Even if the physician to whom the child is referred elects to use chelation therapy, such therapy will only be of benefit in the long run if the sources of overexposure to lead in the child's environment are identified and effectively reduced.

F. Use of Health Criteria in Deriving a Target Soil/Dust Lead Guideline Concentration

1. Choice of model

A single number for a lead in soil guideline to protect young children was considered unrealistic for a number of reasons. Various levels of blood lead concentrations are used as health standards around the world and these levels are changing as different criteria and effects of lead are considered. The environment of the population at risk can vary widely, from urban dusts derived from automotive emissions and leaded paints to smelter emissions, old mining areas, waste disposal sites or other sources. The population at risk can itself vary, to include situations where there is a high proportion of young

children, a retirement home for the elderly, or vacant land proposed for development. Because of these considerations, the soil/dust guideline was established as a relationship or formula, in order to allow for a variety of environmental situations and regulatory criteria. A number of recent papers have discussed modelling techniques applicable to multiple source exposure to lead (Kneip et al, 1983; USEPA, 1986, 1988; Hoffnagle, 1989; Marcus and Cohen, 1989), and are discussed below. Alternate models can of course be used within the framework of this document according to the data available and any other priorities.

In the model used here, blood lead concentration is equated to a baseline level plus an increment resulting from exposure to soil or dust lead. The model takes account of the chosen blood lead guideline or target concentration and the degree of protection required in the population. The slope of the blood lead - soil lead relationship used in calculating increase in blood lead over a baseline value, and hence the soil guideline, can vary depending on a variety of factors, and this response can be adjusted for a given situation and modified as more data become available.

The relationship derived is as follows:

$$S = \frac{\left[\frac{T}{G^B} - B \right]}{\delta} \cdot 1000$$

Figure 2. Derivation of blood lead/soil lead model.

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where:

S is the soil or dust guideline, a geometric mean concentration in $\mu\text{g Pb}$ per gram of dust (ppm)

T is the blood lead guideline or target concentration, in $\mu\text{g Pb/dl}$ whole blood

G is the geometric standard deviation of the blood lead distribution, typically in the range of 1.3 to 1.5

n is the number of standard deviations corresponding to the degree of protection required for the population at risk, and would normally follow from the way in which the blood lead guideline T was defined. For example if 95% of the population should have blood lead concentrations less than 20 $\mu\text{g/dl}$. n can be obtained from standard statistical tables, and some representative values are given below for different percentages of the population desired to be below the target blood lead concentration.

Percentage of <u>population < T</u>	approximate value of <u>n</u>
50	0 (target is mean)
95	1.64
98	2.05
99	2.32
99.9	3.04

B is the background or baseline blood lead concentration in the population from sources other than soil and dust. Data from an appropriate control group would be ideal - a group matched not only for population characteristics, but also for similar lead

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exposure from all sources except soil and dust. If there are appreciable contributions from other sources such as smelter emissions or leaded paint, these must be measured or estimated for addition to the baseline value. If these data are not readily available, any proposed investigation should evaluate the contributions from other suspected sources.

δ is the slope or response of the blood lead - soil(dust) lead relationship and has the units of $\mu\text{g Pb/dl blood increase per } 1000 \text{ ppm increment of soil or dust lead}$.

2. Factors Affecting δ

The major uncertainty is the value to use for δ , the response of blood lead to increasing soil or dust lead concentration. A number of studies giving information on this relationship were considered, but it is not our intention to review them here, as most have already been considered in detail by the USEPA (1986) and by Duggan and Inskip (1985). These reviews also present a considerable number of other references relating the importance of dust and soil exposure to young children. A list of the papers considered is given in Table 1 along with details of the populations studied, the range of soil, dust and blood lead concentrations observed, and the estimated slope of the soil/dust - blood lead relationship. However, a number of observations need to be made, which bear on the choice of a value of δ to be used in this guideline model.

The range of slopes reported is wide, from 0.9 to 9.0 $\mu\text{g Pb/dl per } 1000 \text{ ppm lead in soil or dust}$. Because of differences in design, the studies are not readily comparable. Some of the

Table 1

**Studies Relating Blood Lead
and Soil or Dust Lead Concentrations**

Study	Area ¹	Soil/Dust Conc. ² µg Pb/g (ppm)	Blood Lead ² µg Pb/dl	Age years	Number	Est. Slope µg Pb/dl blood per 1000 ppm soil or dust	Review
Bornschein et al (1989) Telluride, CO	H	172S 281 - 567D	6	<6	94	2.2	
Hoffat (1989) Dumfries, Scotland	H	213 - 6902S 320 - 1570D	10 - 18	<12	37	1.2	
Phillips et al (1988) Herculaneum, MO	H	70 - 2258S 170 - 2080D	7 - 22	1-5	229	2.2	
Rabinowitz and Bellinger (1988) Boston, MA	U	702S (7-11,240)	6	0.5-2	195	0.9	
Laxen et al (1987) Edinburgh, Scotland	U	500D (48-13,600)	11 (3-34)	8-9	495	1.9	
Milar and Mushak (1982) Raleigh, N.C.	D	250 - 3000D	18 - 44	1-4	47	9.0	D
Reeves et al (1982) Auckland, N.Z.	U	24 - 842S	12 - 19	1-3	195	5.0	D

Table 1 (continued)

Studies Relating Blood Lead
and Soil or Dust Lead Concentrations

Study	Area ¹	Soil/Dust Conc. ² µg Pb/g (ppm)	Blood Lead ² µg Pb/dl	Age years	Number	Est. Slope µg Pb/dl blood per 1000 ppm soil or dust	Review ³
Stark et al (1982) New Haven, CT	U	230 - 1330S 160 - 630D	27	0-1 2-3 4-7	153 334 439	2.2 2.0 0.6	E
Roels et al (1980) Belgium	S	112 - 2560D	9 - 25	10-14	148	2.1, 3.5	D, E
Angle and McIntire (1979, 1982) Omaha, NE	U	81 - 139S 211 - 479D	23 - 30	1-18	831	4.0, 6.8	D, E
Neri et al (1978) Schmitt et al (1979) Trall, NC	S, U	225 - 1800S	19 - 29	1-3 6	87 103	7.6, 8.8 4.6, 7.2	D, E
Watson et al (1978) Vermont	B	718 - 2239D	21 - 32	1-6	59	6.8	D
Baker et al (1977) Memphis, TN	S	500 - 5500D	22 - 64	1-6	32	8.6	D

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Table 1 (continued)

Studies Relating Blood Lead
and Soil or Dust Lead Concentrations

Study	Area ¹	Soil/Dust Conc. ² µg Pb/g (ppm)	Blood Lead ³ µg Pb/dl	Age years	Number	Est. Slope µg Pb/dl blood per 1000 ppm soil or dust	Review ³
Yankel et al (1977) Walter et al (1980) Silver Valley, ID	S	400 - 7500S	21 - 66	1-9	860	1.1	D,E
Barltrop et al (1975) Derbyshire, England	M	420 - 11970S 530 - 2580D	21 - 29	2-5	82	2.3	D,E
Galke et al (1975) Charleston, SC	U	173 - 1400S	32 - 43	<5	187	2.5	D,E
Shellishear et al (1975) Christchurch, NZ	U	150 - 1950S	18 - 25	1-5	68	3.9	D,E
Roberts et al (1974) Toronto, Canada	S,U	99 - 1715S 713 - 1550D	17 - 27	0-14	1125	6.0	D

Notes:

1. Area: B - battery plant, M - mining area, S - smelter, U - urban.
2. Soil (S), Dust (D) and Blood lead concentrations: means given for low and high lead areas; otherwise, range of individual results in ().
3. Review: study reviewed by D - Duggan and Inskip (1985) or E - USEPA (1986)

children studied were obviously exposed from multiple sources, and few of the studies measured all of the major sources of exposure either for individuals or adequately for the groups investigated. The age range of children was large, from less than 1 to 18 years of age, and widely differing environments were studied - smelter and battery plant exposure, old mining districts, and urban areas. Many of the baseline or background blood lead concentrations were considerably elevated by today's standards. In spite of these caveats, choices must be made, and the major factors to be considered in choosing a slope would be:

- a. The age distribution of children in the population at risk -two year old children exhibiting frequent hand - to - mouth activity would be expected to have a higher δ than teenagers;
- b. The physical availability of dust and soil to child - grass covered, dusty site, cleanliness of home, etc;
- c. The bioavailability of lead in dust and soil. This can vary with lead concentration in the dust or soil, the adsorption capacity of the soil/dust for lead, the chemical species of lead present (mine spoil compared to urban or smelter polluted soils and dusts), age of deposit, other soil components, etc. (discussed more fully in the supplemental materials); and
- d. The cultural/ethnic differences, such as parental supervision, time spent in/outside home, degree of clothing covering body surfaces, pica and mouthing habits, etc.

3. Choice and Use of δ

In the review papers cited above, Duggan and Inskip (1985) chose to use a value of 5 for δ , being the average of the studies reviewed. The EPA review placed particular emphasis on the results of one study (Stark et al, 1982) in that it provided good data for slope estimation, as well as providing data for both soil and house dusts for young children. These data indicate a δ of about 2 $\mu\text{g}/\text{dl}$ per 1000 ppm dust or soil.

Recent studies by Bornschein et al (1989) and by Laxen et al (1987) also indicate a δ of about 2, while Rabinowitz and Bellinger (1988) report a value of 0.9 for well maintained middle class neighborhoods. Marcus and Cohen (1989) suggest a value of 2 as the most likely value, this being the median of the values reported in the papers noted in these reviews.

It would appear that a value in the range of 2 - 5 would be appropriate for most situations. However, this should be adjusted in light of particular knowledge for a given situation. Low deltas would tend to result in groups with: 1) older children; 2) well maintained of vegetative cover; 3) mine tailings (poor bioavailability); 4) cleaner homes and more frequent handwashing; or 5) heavier textured soils. Conversely, higher δ 's would tend to be found in groups with: 1) children of peak lead absorbing and soil ingesting age, 18-24 months; 2) dusty conditions, sparse vegetative cover(i.e., bare soil) ; 3) homes with poor cleanliness and infrequent handwashing; 4) soil lead sources with slight soluble lead salts such as automotive and stack emissions or well oxidized and more soluble sources including exterior paint; or 5) light textured or low organic

matter soils. The major influence on a value for δ may in fact be child activity, rather than any characteristics of dust or soil.

Tables 2-5 give examples of the soil guideline derived for different target blood lead concentrations and by varying other parameters in the model. Any value chosen should of course be modified in light of future research, and in particular from any investigation initiated as a result of using the guideline defined here. It must be emphasised again that these are theoretical calculations, and if adequate blood lead data are or become available, they should of course take precedence in any decision making process.

A means of setting a guideline for undeveloped land is suggested, and a number of examples of calculating a soil guideline for different situations and health criteria are also given setting a guideline based on protecting the most sensitive individual rather than a population based guideline.

Table 2

Variation of Soil Lead Guideline
with Target Blood Lead Concentration
and Degree of Desired Protection

Target PbB $\mu\text{g/dl}$	Soil Lead Standard for % of Population < Target PbB				
	50%	95%	98%	99%	99.9%
10	3000	880	500	300	-
15	5500	2300	1860	1400	700
20	8000	3750	3000	2600	1600
25	10000	5200	4250	3700	2500

Assumptions: $\delta = 2$, Background PbB = 4 $\mu\text{g/dl}$, GSD = 1.4

Table 3

Effect of Variation in δ and Target PbB
on Soil Lead Guideline

Target PbB	δ , ($\mu\text{g Pb/dl blood}$) (mg Pb/ kg soil) ⁻¹			
$\mu\text{g/dl}$	1	2	4	8
10	600	300	150	75
15	2900	1400	700	350
20	5200	2600	1300	650
25	7500	3700	1850	925

Assumptions : 99% of population < PbB-T; GSD = 1.4,
Background PbB = 4 $\mu\text{g/dl}$

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Table 4

Effect of Variation in the Geometric Standard Deviation (GSD)
of the PbB distribution on Soil Lead Guideline

Target PbB	Geometric Standard Deviation					
$\mu\text{g/dl}$	1.3	1.4	1.5	1.6	1.7	1.8
10	720	300	-	-	-	-
15	2100	1400	930	520	190	-
20	3400	2600	1900	1350	920	560
25	4800	3700	2900	2200	1650	1200

Assumptions: $\delta = 2$, Background PbB = 4.0, 99% of population < Pb-T

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Table 5

**Effect of Variation in Background PbB
on the Soil Lead Guideline**

Target PbB $\mu\text{g/dl}$	Background PbB, $\mu\text{g/dl}$				
	2	4	6	8	10
10	1300	300	-	-	-
15	2400	1400	450	-	-
20	3600	2600	1600	600	-
25	4700	3700	2700	1700	700

In this case, 'background' could include other particular sources of lead exposure.

Assumptions: $\delta=2$, $\text{GSD}=1.4$, 99% of population $<\text{PbB-T}$

4. Modelling the Blood Lead/Soil Lead Relationship.

A number of recent papers have discussed modelling techniques applicable to multiple source exposure to lead, (Kneip et al, 1983; USEPA, 1986, 1988; Hoffnagle, 1989; Marcus and Cohen, 1989), and should be consulted for additional discussion.

The 'disaggregate' modelling approach uses empirical relationships between blood lead concentrations and the concentrations of lead in the various media contributing to lead exposure. The slopes or responses of blood lead to differing sources are ideally estimated from regression analyses of epidemiological data. The form of this model is:

$$PbB = sC_s + aC_a + dC_d + wC_w + \dots, \text{ where}$$

PbB is the average blood lead concentration;

s is the slope relating blood lead and soil lead;

a, d, w, . . are slopes for air, diet, water . . ; and

C_s, C_a, C_d, C_w, . . are lead concentrations in soil air, diet, water, etc.

Proper use of this model would require measurement of all source terms as well as having good estimates for all the slopes.

The 'aggregate' model combines in a single slope or coefficient all the direct and indirect contributions of soil lead to blood lead, and also combines the contributions from all other sources into a single factor. It takes the form:

$$PbB = sC_s + B, \text{ where:}$$

s is the slope between blood lead and soil lead;

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C_s is the soil lead concentration; and

B is the contribution to blood lead for all sources other than soil and dust.

This approach has the advantage that it is easy to understand and use, and that the necessary data are available. If any other source(s) make a significant contribution to blood lead, such as smelter emissions for example, this additional term must be measured or estimated and added to the background term B above, in order to make a proper assessment of the contribution of soil lead to blood lead.

A more complex modelling approach is used in the 'biokinetic model'. Daily lead intake from indoor and outdoor air, food, water, dust and soil are calculated using age-specific estimates of parameters such as respiratory volume, amount of soil ingestion, and lead absorption for various routes of exposure through the lungs and gastrointestinal tract. These estimates are then used to calculate an average blood lead concentration. Although this model relies on limited data for some input terms, it can be useful in predicting mean blood lead concentrations from multiple exposure sources and under alternate abatement strategies.

A modified version of the aggregate model was chosen because of its ease of use. As more data becomes available, other models could, of course, be used within the framework established in this document.

5. The Biokinetic Model and Factors Affecting δ .

The model used in this document is based upon a change in blood lead being equal to δ times the soil lead concentration: change in PbB = $\delta \cdot C_s$. This δ can be related to the various factors used in the biokinetic model (USEPA, 1986,1988) and to the factors influencing uptake by the relationship:

$$\delta = (F \cdot I \cdot A \cdot X), \text{ where}$$

F = age-specific factor relating amount of absorbed lead (from any source) to blood lead concentration, taken as 0.4 for 2 year old children;

I = soil or dust ingestion, mg/day;

A = per cent absorption of dietary lead in the gut;

X = product of factors effecting soil lead-blood lead relationship.

The multiple components of factor X can be represented as:

$$X = x_1 \cdot x_2 \cdot x_3 \cdot x_4 \cdot x_5, \text{ where}$$

x_1 = bioavailability of soil or dust relative to normal dietary lead absorption (discussed in the bioavailability section of the report).

x_2 = factor representing physical availability of soil/dust lead. Higher for dry, dusty sites, lower for grass covered sites;

x_3 = factor indicating relative nutritional status of group. Nutritional deficiencies can enhance lead absorption;

x_4 = a social/ethnic index. Well scrubbed, fully clothed children who spent all day indoors would be expected to have a lower soil uptake;

x_5 = any other factors which may influence lead uptake from dust and soil.

6. Guidelines for Undeveloped Land.

In setting a guideline for publicly accessible land which is to be left undeveloped, or in which the lead in soil or dust is unavailable to any young children, say by completely grassing over the site, a modified approach should be adopted. The soil guideline derived by the model adopted here would be too restrictive on land usage and unnecessary to protect public health. Two possible approaches are suggested for such a situation.

a. As soil and dust lead concentrations also follow log normal distributions, a level 2 standard deviations (say) above the guideline derived as above, could be used as a geometric mean guideline level for undeveloped sites. The appropriate formula would be:

$$U = S * G^n$$

where

U is the undeveloped land guideline, a geometric mean concentration.

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S is the guideline derived from the target blood lead concentration for developed land where children may be exposed to soil.

G is the geometric standard deviation of the soil/dust lead concentrations, (typically about 2).

n is the number of standard deviations chosen for the desired level of protection.

b. Alternatively, a different 'level of protection' could be chosen in the original model formula. If, for example, $n=3$ were to be used for populated sites, such that 99.9% of the population should be below the target blood lead concentration, a lower value could be chosen for unpopulated areas, say $n=0$, equivalent to where the mean blood lead concentration would be below the target blood lead concentration.

7. Examples of Soil/Dust Guideline Calculations

a) $T = 15 \mu\text{g/dl}$

$n = 2.05$ for 98% of population less than T

$G = 1.40$

$B = 4 \mu\text{g/dl}$, no other significant sources

$\delta = 2 \mu\text{g/dl}$ per 1000 ppm

$S = (\underline{15} - 4) * 1000 = 1763 \approx 1800 \text{ ppm}$

$(\underline{1.4^{2.05}})$

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b) as above, except take $\delta = 5 \mu\text{g/dl}$ per 1000 ppm

$$S = \frac{(15 - 4) * 1000}{\frac{(1.4^{2.05})}{5}} = 705 \approx 700 \text{ ppm}$$

c) as in a), except air lead contributes an additional $3 \mu\text{g/dl}$ above background to the baseline blood lead concentration

$$S = \frac{(15 - (4 + 3)) * 1000}{\frac{(1.4^{2.05})}{2}} = 263 \approx 250 \text{ ppm}$$

This level of 250 ppm could be used, if no measures were taken to reduce air lead exposure. If such measures were taken, an appropriate S between 250 and 1800 ppm would be recalculated.

d) as in a), except $n = 3.04$ for 99.9% of population less than T

$$S = \frac{(15 - 4) * 1000}{\frac{(1.4^{3.04})}{2}} = 697 \approx 700 \text{ ppm}$$

e) it is desired to set a guideline for undeveloped land using the values as in a), but with $n = 0$ for the mean blood lead to be below T

$$U = \frac{(15 - 4) * 1000}{\frac{(1.4^0)}{2}} = 5,500 \text{ ppm}$$

f) given the guideline of 1800 ppm found in a), it is desired to set a guideline for undeveloped land at 2 standard deviations above the soil mean, using a soil lead geometric standard deviation of 2.0

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$$U = 1800 * 2.0^2 = 7200 \text{ ppm}$$

- g) as in f) above, but taking the mean of 700 ppm found in
b) as a starting point

$$U = 700 * 2.0^2 = 2800 \text{ ppm}$$

h) $T = 25 \text{ } \mu\text{g/dl}$

$$n = 3.04, \text{ for } 99.9\% \text{ of population less than } T$$

$$G = 1.43$$

$$B = 5 \text{ } \mu\text{g/dl}$$

$$\delta = 2 \text{ } \mu\text{g/dl per } 1000 \text{ ppm}$$

$$S = \left(\frac{25 - 5}{(1.43^{3.04})} \right) * 1000 = 1714 \approx 1700 \text{ ppm}$$

- i) as in h), except $n = 3.71$ for 99.99% of population less
than T (10 out of every 100,000 at risk)

$$S = \left(\frac{25 - 5}{(1.43^{3.71})} \right) * 1000 = 816 \approx 800 \text{ ppm}$$

- j) given the guideline of 800 ppm found in b), it is
desired to set a guideline for amenity grassland at 2 standard
deviations above the soil mean, using a geometric standard
deviation of 2.10.

$$U = 800 * 2.10^2 = 3528 \approx 3500 \text{ ppm}$$

- k) it is desired to set a guideline for the amenity
grassland using the values as in h), but with $n = 0$ for the mean
blood lead to be below T

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$$U = \frac{(25 - 5) * 1000}{(1.43^0)} = 10,000 \text{ ppm}$$

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8. Lead in Soil/Dust Guideline Based on the Most Sensitive Individual

The guideline setting approach previously discussed is based upon deltas derived from population studies - in effect a mean response of blood lead to soil or dust lead. Rather than basing a guideline upon a certain percentage of the population being below a target blood lead concentration, say 98% less than 15 µg/dl for example, it may be desired to base a guideline on protecting the most sensitive individual. Such an individual would be the child who ingests large amounts of soil.

In its current use of the biokinetic model, the USEPA (1988) makes use of the studies of Binder et al (1986) and Clausen et al (1987) on estimating the amount of soil ingested by the average child. Current estimates are that this is about 100 mg/day for a two year old, with the 95th percentile about 0.5 g/day and the 99th percentile about 5 g/day. From the relationships previously discussed, delta may be taken to be proportional to the average daily amount of soil ingestion. Using the 'best mean estimates' of 2 for δ and 100 mg/day for soil/dust ingestion, a soil guideline can be calculated for various amounts of soil ingestion which would result in a maximum allowable increase in blood lead concentration above a baseline value. Table 6 illustrates how this may be done for a particular set of assumptions.

Table 6

Soil/Dust Guideline Calculated For Varying Amounts of Soil
Ingestion
And Baseline Blood Lead Concentrations Target PbB of 15 $\mu\text{g}/\text{dl}$
Assumed

Soil/Dust Guideline, $\mu\text{g Pb}/\text{g}$				
Soil Ingestion mg/day	Baseline Blood Lead, $\mu\text{g}/\text{dl}$			
	0246			
100	7500	6500	5500	4500
500	1500	1300	1100	900
1000	750	650	550	450
2500	300	260	220	180
5000	150	130	110	90
10000	75	65	55	45

Using these assumptions, a lead in soil guideline set on the basis of high soil ingestion by a child results in a standard within the range of "normal", uncontaminated soil lead concentrations.

VI. BIOAVAILABILITY

The bioavailable fraction of the total quantity of Pb in a diet is generally defined as that fraction which can be absorbed into the blood stream by the animal species ingesting the diet. Because food constituents also affect Pb absorption, the bioavailability of Pb in test materials such as soil is compared to that of the soluble Pb salt, Pb-acetate, which is considered 100% bioavailable. Research has shown that many factors can influence whether lead in soil and dust ingested by children is actually absorbed into the blood. Physical and chemical properties of the dust particles, nutritional status of the children, and whether the soil is ingested with food or between meals, can each substantially affect whether soil Pb is absorbed. These factors can so strongly affect Pb absorption that decisions to replace polluted soils should consider whether the nature of the Pb species present, and the nature of the soil involved.

Another very important consideration is the effect of increasing soil dose on Pb absorption. If the pica child is to be protected, soil ingestion of the 95th or 99th percentile child (0.5 and 5.0 g/day, respectively; Calabrese et al., 1989) must be considered. However, if Pb absorption approaches a plateau with increasing soil dose, the pica child may be at no greater risk than the median soil-ingesting child. The response to increasing soil dose has been found to plateau in several studies, supporting this model. Further, the adsorption of Pb to soil particles in the small intestine would be expected to cause this response pattern. Similarly, adsorption of Pb by soil particles

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in the intestine allows low soil Pb concentrations to be essentially unavailable compared to higher soil Pb concentrations. Approximately 300 mg Pb/kg was found to be a "no effect" level for Pb in sewage sludge compost ingested by cattle; below this level tissues were not increased in Pb even though the cattle ingested significantly increased amounts of total Pb. Thus, risk from soil Pb is very different than risk from water-Pb, paint-Pb, or food-Pb because these Pb sources do not provide Pb-adsorption capacity along with the ingested Pb.

A. Factors That Influence Risk of Soil Lead (Pb)

Pb concentration in soil, size of soil particles rich in Pb, chemical species of Pb in soil, and nutritional factors together interact with human behavioral factors in controlling risk from soil Pb. It is clear from many studies that children vary remarkably in blood Pb (Pb-B) when exposed to similar Pb sources. Parental supervision, personal habits (mouthing of fingers, hands, toys; chewing fingernails; washing hands), pica behavior, and quality of nutrition vary among children so greatly that some children may have little risk when they live or play in areas with high soil Pb. However, it is necessary to consider the child described by Duggan and Inskip (1985), the average child playing in a normal dirty way. Other authorities (e.g. US-EPA) consider the "most-exposed, most-susceptible individual" (the MEI). In the case of soil Pb risk analysis, this MEI is a poorly-supervised child who is regularly exposed to Pb-rich soil, has pica for soil, and has poor nutrition for factors which interact with Pb absorption. Such a child would therefore ingest

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much soil Pb, and absorb a higher percentage of this soil Pb than would the well-cared-for child.

B. Bioavailability of Ingested Soluble Pb

Research on laboratory animals over many years has characterized the effect of nutritional factors on Pb absorption (Mahaffey, 1982, 1985; Mahaffey and Michaelson, 1980). More recently, adult human Pb isotope absorption studies and Pb balance studies in infants have clarified the understanding of human Pb absorption. In addition, several feeding studies using livestock and laboratory animals have directly tested Pb absorption from dietary soil/dust.

C. Effect of Pb Compound and Particle Size on Pb Absorption

Research has been conducted to evaluate the bioavailability of Pb in different Pb-compounds. Allcroft (1950) reported on long-term feeding studies in which several Pb compounds were fed to cattle, and found great differences between both Pb compounds and different particle sizes of the same compounds. In particular, large particle PbS had much lower toxicity and caused lower tissue levels of Pb than did small particle PbS or other compounds.

Barltrop and Meek (1975, 1979) studied bioavailability of different Pb compounds and paint pigments (of varied particle size) to rats using a 48 hour feeding period. In their work, larger particles had lower bioavailability than smaller particles of several materials. This would appear to result from the poorer dissolution of larger particles during the short period of acidic treatment in the stomach. Compounds which are readily

dissolved in weak acid were highly bioavailable. Thus, some Pb pigments, Pb ores, and paint particles are only partially dissolved in the stomach. Human feeding studies of Rabinowitz et al. (1980) tested the absorption of finely divided PbS to fasting human volunteers. In this test, PbS was highly bioavailable, but this PbS preparation does not simulate Pb ore or Pb ore wastes. More recently, Healy et al. (1982) tested the solubility of different particle size preparations of PbS in gastric fluid. This work confirmed that smaller particles of PbS were dissolved more rapidly than larger particles. Their work was focused on bioavailability of PbS from cosmetics (e.g. surma) which appear to be transferred to the mouth after hand contact (Healy et al., 1982; Healy, 1984). The implication of these findings for soil Pb are that larger particle size PbS (e.g. galena ore particles dispersed by mining, transport, or smelting) would be expected to have significantly lower bioavailability than other soil Pb.

D. Effect of Nutritional Factors on Pb Absorption

Feeding studies to assess the effect of nutritional status, on Pb absorption have shown that a deficiency of calcium (Ca) or iron (Fe) increase Pb absorption (Mahaffey, 1981, 1985). When dietary Ca fell below about 50% of the dietary levels recommended by the National Research Council (NRC) for growing rats, Pb absorption strongly increased (Mahaffey et al., 1977). Mahaffey (1981) has summarized these nutritional interactions in relation to known dietary limitations in urban poor children and pregnant women, the largest groups who comprise the "most-susceptible" individuals for excessive soil Pb.

Iron deficiency was also found to strongly affect Pb absorption in rats. Pb absorption declined with a further increase in dietary Fe above the minimum dietary requirement. Because many children are Fe deficient, this nutrient could be important in assessing risk of soil Pb ingestion. However, results from two independent research programs found opposite effects of Fe-deficiency on Pb absorption by adult humans. The Watson et al. (1980) study reported that individuals with low serum ferritin (indicating low body Fe reserves), who absorb an increased fraction of dietary Fe, also absorbed increased amounts of carrier free Pb. However, Flanagan et al. (1982), using ²⁰³Pb with 200 µg carrier Pb, found no effect of Fe status (serum ferritin) or added dietary Fe on Pb absorption by humans. This was a direct test of the Watson et al. report, but used an improved experimental design.

One of the most important findings of this human Pb absorption research was that Pb absorption is greatly reduced by simultaneous ingestion of food (Blake et al., 1983; Flanagan et al., 1982; Heard et al., 1983; James et al., 1985; Chamberlain, 1987; Rabinowitz et al., 1980) compared to Pb ingested during fasting. The effect of a meal on Pb absorption lasted about 2-3 hours after eating because of slow gastric emptying after a meal (James et al., 1985). This result has important implications for absorption of soil/dust Pb compared to water Pb or paint Pb ingested between meals. Studies of which dietary components reduce Pb absorption identified minerals (Ca, phosphate (P), phytate (inositol hexaphosphate), and fibre (Blake et al., 1983;

Blake and Mann, 1983; James et al., 1985). Combinations of Ca and P had more effect on Pb absorption than did Ca alone (Blake and Mann, 1983; Heard et al., 1983). In other work, Pb isotopes were incorporated into lamb liver and kidney, and into spinach to allow comparison of Pb intrinsic to a food with Pb isotope extrinsically added to a meal with that food. This research showed that "food" Pb was absorbed equal to Pb salts added to an equivalent meal (Heard et al., 1983).

Pb in oysters was about 70% as bioavailable to Japanese quail as Pb acetate added to the purified diet (Stone et al., 1981). James et al. (1985) evaluated a number of meals and dietary components. Test meals components such as phytate or EDTA (ethylenediaminetetraacetate) reduced Pb absorption compared to the effect of an equal amount of Ca and P in a low phytate refined diet basal meal (James et al., 1985; Flanagan et al., 1982). On the other hand, milk in a meal increased Pb absorption compared to the expected effect of an equivalent amount of Ca and P in the milk. Thus, phytate, fibre, and Ca in whole grain foods would tend to appreciably reduce Pb absorption compared to more highly refined grain products.

As observed with other nutrients, Pb absorption is proportional to the activity of free Pb^{2+} ions in the intestine. For example, addition of EDTA to a test diet reduced absorption (Flanagan et al., 1982; James et al., 1985) because chelation of an element reduces its chemical activity. The role of phytate (James et al., 1985; Wise, 1981), and some tannin and fibre components (Peaslee and Einhellig, 1977; Paskins-Hurlburt et al.,

1977) should be similar to EDTA. Soil and dust should act like fibre in this regard, by adsorbing Pb and reducing Pb^{2+} ion chemical activity, thereby reducing soil Pb bioavailability.

These results on the importance of Ca and P concentration in test human diets on Pb absorption raises the question "How do Ca and P interfere with Pb absorption?" There are several possible mechanisms. One is simple interaction of Ca and Pb at the intestinal Pb absorption site. However, this mechanism would not explain why P is shown to be significant in humans. The most likely mechanism for the effect of Ca and P on Pb absorption appears to be co-precipitation of Pb with Ca-phosphates formed during the digestion process. Co-precipitation of Zn with Ca-phosphates indicates how this might occur. Nelson et al. (1985) first studied model systems and found that Ca-phosphate quickly (within minutes) formed when Ca and PO_4 were present at levels common in whey, the solution remaining after curds form in acidified cow's milk. Further study showed that Zn coprecipitated with the Ca-phosphates above pH 5.0 as the pH increased and coprecipitation was complete by pH 6.0 (Nelson et al., 1987).

This may be very likely the model for the effect of dietary Ca and P on Pb absorption. The clear interaction of dietary Ca and P concentrations in animal and human studies of Pb absorption fit a solubility product model. Pb coprecipitation with Ca-phosphate should be complete at even a lower pH than found for Zn.

E. Bioavailability of Lead in Ingested Soil and Dust

One approach to this question is what happens to wildlife who live in areas with high soil Pb. Wildlife are unable to avoid exposure to and usually show at least some absorption of soil/dust Pb from their habitat (Elfving et al., 1978; Hutton and Goodman, 1980; Ireland, 1977; Scanlon et al., 1983; Young et al., 1986). These studies suggested appreciable bioavailability of soil/dust Pb, but did not make specific comparison with soluble Pb salts added to control diets. Similarly, livestock grazing pastures on soils rich in Pb (mine wastes, naturally Pb-rich soils) had increased Pb levels in body tissues showing soil Pb had at least some bioavailability, but much less than for soluble Pb sources (Allcroft, 1950; Egan and O'Cuill, 1970; Harbourne et al., 1968; Wardrope and Graham, 1982).

The "contribution from lead in mining wastes to blood lead" has recently been addressed in a comprehensive review by Steele, et al (1990). Their evaluation of studies for mining areas found no strong correlation between soil lead and blood lead and no elevated blood lead concentrations in areas with very high soil lead concentrations (Heyworth, 1981), or slopes at the low end of the range as noted by the EPA (Barltrop, et al, 1975; Barltrop, et al, 1988). The report notes that while epidemiological studies may not be conclusive, when viewed together, they do indicate that mining wastes may be different from other soil/dust lead sources in contributing to blood leads.

The extensive report by Steel et al. (1989) also indicated that the possible reasons for a reduced impact of lead sulfide in

soils contaminated by mine wastes (PbS is the Pb chemical species from Pb ore remaining in mine tailings) on blood lead in children living in mining communities are that mine wastes have larger particle size which decreases the bioavailability of lead in the gastrointestinal tract. Also lead sulfide resists absorption in the gastrointestinal tract when compared to other forms of lead.

Several studies were conducted to directly test the bioavailability of soil/dust Pb to animals. Stara et al. (1973) reported studies of rats fed tunnel, highway, or smelter dusts. Accumulation of Pb in bone or kidney was non-linear with dose (Table 7), with lower %-absorption as dose increased. Bone lead tended to approach a plateau as the amount of soil Pb in the diet increased. Another way to view these results is that the highest %-absorption of soil Pb occurred at the lowest soil ingestion level. Table 8 shows results from their comparison of the absorption of Pb by rats fed different dust sources. El Paso smelter dust (0.67% Pb) had appreciably lower effect on blood Pb than Queens tunnel dust (2.22% Pb) or Los Angeles freeway dust (1.04% Pb) when the rats were fed 1 mg Pb/d as dust in gelatin capsules, equivalent to about 100 mg Pb/kg diet. Bone and kidney Pb were also lower for the lower Pb concentration smelter dust than for the tunnel or freeway dusts. These tests did not compare absorption of Pb from dusts with Pb acetate. This work used a purified diet rather than a lab chow diet which favored Pb absorption.

Dacre and TerHaar (1977) conducted an evaluation of the bioavailability of Pb in houseside soil (990 mg Pb/kg) and

roadside soil (2300 mg Pb/kg) compared to Pb acetate. Equal Pb concentrations were added to diet from the three sources, 50 mg Pb/kg diet. A high fibre, high nutrient rat chow was used as the basal diet. Much lower blood-Pb and bone-Pb levels were reached in their experiment than seen by Stara et al. (1973) (Table 9). Bone and kidney Pb concentrations after 90 days feeding showed that soil Pb had significantly lower effect than Pb acetate. Bone results indicated that soil Pb was about 70% as bioavailable as Pb acetate.

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Table 7

Effect of the daily dose of ingested dust-Pb on Pb in tissues of rats fed Queens, NY tunnel dust (sieved) mixed in purified diet for 42 days before analysis of tissues. Dust contained 22 g Pb/kg (Stara et al., 1973).

Daily Dose	<u>Blood</u>	<u>Tissue Pb</u>			
	Peak Pb	Femur	Kidney	Liver	Brain
mg Pb/d	µg/dL	----- µg Pb/g tissue -----			
0.0	11	0.75	-	0.13	0.032
0.5	33	25.7	2.5	0.56	0.030
1.0	39	33.6	3.2	0.52	0.055
5.5	51	66.1	9.4	1.3	0.28

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Table 8

Effect of dust source and Pb concentration on Pb in tissues of rats fed dust supplying 1 mg Pb/day for 36 days. (Stara et al., 1973).

<u>Dust Source</u>	<u>Dust-Pb</u>	<u>Blood</u>	<u>Tissue Pb</u>			
		<u>Peak-Pb</u>	<u>Femur</u>	<u>Kidney</u>	<u>Liver</u>	<u>Brain</u>
	mg/g	µg/dL	----- µg Pb/g tissue -----			
Control	-	12	0.75	-	0.13	0.032
NY Tunnel	22.2	45	33.6	3.2	0.52	0.055
LA Freeway	19.4	39	32.5	2.7	0.32	0.094
El Paso Smelter	6.7	32	23.6	2.5	0.36	0.035

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Table 9

Bioavailability of soil Pb compared to Pb acetate fed to rats at 50 mg Pb/kg diet for 30 or 90 days mixed in a laboratory chow diet (Dacre and TerHaar, 1977). Roadside soil fed at 2.15% of diet; houseside soil fed at 5.0% of diet.

Diet	Soil Pb	Measured	<u>Bone Pb, mg/kg</u>		<u>Kidney Pb</u>
	Concn.	Diet Pb	@ 30 days	@ 90 days	@ 90 days
	mg/kg	mg/kg	-----mg Pb/kg-----		
Control	-	0.6	1.71 a	1.27 a	0.25 a
Roadside	2300	56.0	5.93 b	4.48 b	0.77 b
Houseside	990	51.8	5.20 b	4.98 b	0.76 b
Pb acetate	-	49.1	5.21 b	6.28 c	0.96 c

Means in a column followed by the same letter are not significantly different.

Chaney et al. (1984) reported data from a more detailed evaluation of the effect of soil on dietary Pb absorption (Table 10). Rats were fed purified complete casein-sucrose purified diets with and without 5% uncontaminated soil, and with and without 50 mg Pb (as Pb acetate)/kg diet to test the effect of dietary soil on absorption of soluble Pb salts (50 mg Pb/kg diet and 50 g soil/kg diet = 1000 mg Pb/kg "soil" during test). Rats were also fed five Baltimore urban garden soils to compare bioavailability of real Pb-rich urban soils with that of Pb acetate. All Pb was added at 50 mg Pb/kg dry diet (unequal soil amounts). The results are shown in Table 10. Bone Pb concentrations were used to evaluate diet Pb bioavailability. The addition of 5% uncontaminated soil to the diet reduced Pb acetate control to 53% of Pb acetate alone. Four soils with about 1000 mg Pb/kg yielded bone Pb about 24% (15-44) of Pb acetate, while a garden soil with 10240 mg Pb/kg yielded bone Pb 70% of the Pb acetate control. Pb in real soils was appreciably less bioavailable than was Pb-acetate freshly mixed with soil. The general trend showed increased soil Pb bioavailability at higher soil Pb concentration (when soil Pb concentrations were higher, percent soil in the diet was correspondingly lower). This may be expected because soil acts like a fibre and a Ca and P source in the diet. These properties should allow soil to adsorb Pb in the lumen of the intestine and reduce net Pb absorption.

The use of purified diets (Chaney et al., 1984) yielded much greater Pb absorption from dietary soil than that found by Dacre

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Table 10

Effect of soil on bioavailability of Pb to rats, and bioavailability of Pb in urban garden soils.

Treatment ¹		Pb in Tibia		Pb absorption
PbOAc	Soil	mg/kg tibia ash		compared to that
		mean \pm std. err.		of Pb acetate, %
-	-	0.3	\pm 0.3 e ²	-
-	11 ³	0.0	\pm e	-
+	-	247.0	\pm 10.1 a	100
+	11 ³	130.0	\pm 29.5 bc	53
-	706	40.0	\pm 6.1 de	16
-	995	108.0	\pm 26.3 c	44
-	1080	37.1	\pm 7.3 de	15
-	1260	53.6	\pm 7.4 d	22
-	10240	173.0	\pm 21.8 b	70

¹A purified casein-based complete diet was fed to Fisher rats for 30 days. Pb acetate and garden soils were added to supply 50 mg Pb/kg dry diet. The experimental garden soils comprised 7.08, 5.02, 4.64, 3.95, and 0.488 % of the dry diet, respectively; control soil was fed at 5% of diet.

²Means followed by the same letter are not significantly different ($P < 0.05$) according to Duncan's Multiple Range Test.

³Unpolluted farm soil near Beltsville, MD, (Chillum silt loam, 11 mg Pb/kg), similar to original soil in the urban gardens used in this experiment.

and TerHaar (1977). The experimental protocols were similar, and dietary Pb was fed at the same level. Pb in tibia ash reached 247 mg Pb/kg in rats fed 50 mg Pb (Pb acetate)/kg purified diet, but femur Pb reached only 5-7 mg Pb/kg in rats fed the same level of Pb in a lab chow diet (Dacre and TerHaar, 1977). Mahaffey and Michaelson (1980) discussed this phenomenon, and stated it resulted from the much higher levels of Ca, Fe, and fibre in chow diets compared to "NRC" purified complete diets. A similar effect of diet was observed by Mylroie et al. (1978) in a direct comparison of diet type on the absorption of paint Pb (Table 11). Much higher bone and kidney Pb were reached using the purified complete rat diet normally recommended for toxicology studies. In many ways, these purified diets are similar to US diets because of low fibre and mineral levels (Mahaffey, 1985).

Research on risk from Pb in ingested sewage sludge also provides data relevant to the question of bioavailability of urban soil Pb. Sewage sludge has been added to usual (or practical) diets of livestock to evaluate food chain transfer (bioavailability) of Pb and other potentially toxic materials in the sludges. Substantial percentages of sludge in diets were used to simulate poor livestock management (worst case) situations in which cattle ingest up to 14% soil (Fries et al., 1982). Sludges used in these studies contained varied levels of Pb and other elements such as Fe and Ca known to interact with Pb. Studies reported by Kienholz et al. (1979) and Johnson et al. (1981) in which cattle ingested sludge with 780 (Table 12) or 466 mg Pb/kg, respectively, found increased bone, liver, and

Table 11

Effect of lab chow versus purified diet on absorption of Pb from paint chips fed at 1% of diet for 35 days. Paint contained 10% Pb as Pb-octoate; diets contained 1000 mg Pb/kg (Mylroire et al., 1978). Diet type affected tissue Pb concentration in each tissue ($P < 0.01$).

Diet Type	Pb-Blood	Pb-Femur	Pb-Liver	Pb-Kidney
	$\mu\text{g/dL}$	----- $\mu\text{g/g}$ wet weight -----		
Lab Chow	<10	97	0.24	5.6
Casein-sucrose	140	400	2.7	300.

Table 12

Effect of percentage of sewage sludge in diet on Pb residues in tissues of cattle which consumed the test diets for 180 days (Kienholz et al., 1979). The digested sludge was from Denver, Colorado, and contained 780 mg Pb/kg.

Sludge	Diet	<u>Pb in tissues</u>		
in Diet	Pb	Kidney	Liver	Bone
<hr/>				
‡	-----mg Pb/kg dry wt.-----			
0	0.5	0.9 a	0.2 a	0.8 a
4	29.0	12.2 b	3.3 b	3.7 b
12	80.0	15.8 c	4.6 c	11.0 c

Within a column, means followed by the same letter are not significantly different at the 5% level.

Table 13

Effect of percentage of sewage sludge compost in diet on Pb residues in tissues of cattle which consumed the test diet for 180 days (Decker et al., 1980). The compost contained 215 mg Pb/kg, and high levels of Fe and Ca.

Dietary Compost	Pb concentration					
	Diet	Feces	Duodenum	Liver	Kidney	Femur
-----mg Pb/kg dry weight-----						
0.	6.0 a	14.7 a	2.81 a	2.36 b	3.96 ab	3.70 a
3.3	11.2 b	23.8 b	3.18 a	2.48 b	5.26 a	4.74 a
10.0	19.9 c	46.7 c	4.21 a	8.44 a	2.92 b	3.37 a

Within a column, means followed by the same letter are not significantly different at the 5% level.

kidney Pb. Response was curvilinear, with the slope of increase in tissue Pb decreasing at higher sludge dose.

In other studies, cattle grazing pastures amended with sludges or sludge compost containing lower amounts of Pb (380 mg/kg) had no significant change in bone or liver Pb concentration (Decker et al., 1980). Cattle fed sludge compost containing 215 mg Pb/kg had little change in bone Pb (Table 13). This confirms that the soil matrix can greatly reduce the bioavailability of Pb in ingested soil-like materials. This work also indicates that soil may adsorb Pb so strongly that Pb-B is not increased until some threshold soil-Pb concentration is exceeded. The threshold was found to be about 300 mg Pb/kg for sewage sludge compost ingested by cattle (Chaney et al., 1989).

Many scientists have considered the bioavailability of Pb in ingested soil and dust (Chaney et al., 1984; Day et al., 1979; Duggan and Inskip, 1985; Ferguson, 1986; Gibson and Farmer, 1984; Harrison et al., 1981; Thornton, 1986). Some have conducted chemical extractions to simulate conditions of the stomach, and found soil Pb was very soluble (Chaney et al., 1984; Day et al., 1979; Duggan and Inskip, 1985; Ferguson, 1986; Harrison et al., 1981). Although some argue that solubility means availability, the above research shows that soil components may adsorb stomach-solubilized Pb at the pH of the intestine and thereby reduce Pb absorption. This effect would cause increased Pb absorption at higher soil/dust Pb concentration at any particular Pb dose. Further, the above research showed that a decreasing response slope results when increasing amounts of a soil are fed.

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These responses are different characteristics of the bioavailability of soil Pb in the diet.

F. Potential Importance of Stomach pH on Absorption of Pb from Ingested Soil and Dust.

Questions have been raised about which soil properties most reduce Pb bioavailability and which experimental animal species might be the most appropriate models for determining the risk to infants/children from the Pb in urban soils, mine wastes, Pb-ore concentrates, smelter wastes, and Pb-paint contaminated soils. Because of the potential effect of stomach acidity on rate of dissolution for PbS, etc., stomach pH was re-considered. In particular, an evaluation was made of stomach pH and the effect of soil ingestion on soil pH of humans, pigs, and rats, because of the apparent importance of stomach pH in the dissolution of PbS and soil Pb. Many Superfund sites involve mine wastes which appear to contain predominantly PbS. If PbS has low bioavailability to humans under normal environmental exposure conditions for the worst case children, the cost of remediating these sites may be much reduced if the Pb in the mine waste/soil is known to have lower bioavailability than that found in soils contaminated by smelter emissions, automotive emissions, or paint residues. These latter sources have been found to cause increased PbB in children exposed to soils when soil Pb exceeds 500-100 mg/kg (CDC, 1985; EPA, 1989 OSWER directive; EPA, 1986 Air Quality Criteria Documents; Duggan and Inskip, 1985). Pb-B in children exposed to PbS in mine wastes or ore concentrates appeared to have substantially lower response to this source than

seen in other populations exposed to more soluble Pb species in soil or dust (Middaugh et al., 1989; Steele et al., 1990).

Research has shown that PbS dissolution is very dependent upon pH. The chemical solubility of PbS responds to both pH and particle size (Healy et al., 1982, Roy, 1977). Because of the short incubation of food in the stomach, and possibly because of the pH buffering of food, mine wastes, PbS, and larger particle size materials should not be expected to be dissolved in the stomach. PbS was found to be very much less soluble in human gastric juice than were Pb carbonates and sulfates (Carlson and Woefel, 1913; Woefel and Carlson, 1914). Chamberlain et al (1978) fed fine PbS with food to human volunteers and found about 6-12% absorption.

Thus, the actual pH of the stomach contents during digestion of soil might be very important in assessing risk from soil ingestion. Researchers on microelement nutrition have considered the pH of the stomach and the duodenum in order to develop in vitro Fe bioavailability assays (Miller et al., 1981; Schricker et al, 1981; Reddy et al, 1988). It is difficult, but one must consider stomach pH under both the fasting condition and the effect of food (or soil) on the pH of the stomach contents. The number generally described as the pH of the stomach is the pH of gastric fluid secreted by fasting individuals. Actually, much is known about this because the importance of gastric fluid pH on ulcer development in humans. Hereditary, hormonal and dietary influences on gastric acid secretion cause pH to vary from 1.0 to 2.5 (or even as high as 7 with poor ability to secrete stomach

acid, e.g. in achlorhydria; Bezwoda et al., 1978). However, as soon as food is ingested, the buffering capacity of the food causes the pH of the stomach contents to rise (Longstreth et al., 1975; Malagelada et al., 1976; Malagelada et al., 1977; Malagelada et al., 1979). Many of the techniques developed and studies conducted gained more information about the nature of ulcer disease in humans which was a result of excessive gastric acid secretion or sensitivity of stomach or duodenal tissues to stomach acid. Compounds used to counteract ulcer inhibit acid secretion, and raise the pH of the stomach (e.g. Lucey et al., 1989). Antacids also react with gastric acids to raise stomach pH. Therefore, soil would also cause the pH of the stomach to rise. The presence of CaCO_3 , especially finely divided CaCO_3 in calcareous soils, but also neutral soils with higher cation exchange capacity, would cause a similar increase in pH of the stomach contents.

It is generally agreed that normal gastric fluid pH is 1-2 in rats, pigs, and children. However, infant (pre-weaning, <24 days old) rats have high stomach pH (6-7), and the transition to strongly acidic stomach pH is delayed as compared to children (Takeuchi et al., 1981). Dr. L. R. Johnson (1990) who had performed extensive research on gastrointestinal physiology with rats noted that another likely source of possible misunderstanding about stomach pH results from the way we manage rats. The fasting rat stomach fluid pH is 1-1.5; however, the rat usually eats intermittently/continuously (nibbles), and much data about the rat stomach pH shows a higher pH level because

food is present in the stomach. The human eats meals, and accumulates a "basal" gastric fluid of pH 1-2 in the antrum of the stomach. But when food is ingested, the pH rises to 5-6. The rat continuously secretes stomach acid, and secretion responds to several hormone activities. The human has a low basal secretion, but hormones significantly increase acid secretion when food is ingested or the stomach is distended. When fed rat chow, the rat stomach empties slower than do human stomachs, but this may be an artifact of the highly digestible type human foods compared to rat chow. Johnson (1990) notes that rat and human stomach pH levels are not that dissimilar, and that rats are a valid model for processes which are pH dependent such as Pbs dissolution. Both secrete a solution which is about 100-150 mM HCl.

Another source of information about stomach pH comes from the work of Dr. G. Bates (1990) who has been studying the bioavailability of food Fe, and trying to develop in vitro methods to assess the bioavailability of Fe. This in vitro work used cannulated miniature pigs were fed test meals, then gastric fluid and duodenal fluid were sampled. A pinto bean meal caused stomach pH to be 5.1, 4.0, and 3.1 at 30, 60 and 90 minutes after introduction of the homogenized slurry of pinto beans test meal (not by stomach tube) (Reddy et al., 1988). These pH levels are very similar to the results for adult humans from Malagelada et al. (1976; 1979).

These considerations indicate that the stomach pH of rat, pig, and human children are not different enough to justify use

of the pig rather than the rat in assessing bioavailability of Pb in soils and mine wastes. Because of the potential extreme public expense in remediating Pb polluted urban soils and mine wastes, important principles of soil-Pb bioavailability shown in rats may need to be confirmed in pigs and primates to win public acceptance of these costs.

It is important to consider that food and soil can buffer the pH of the stomach to high levels, > pH 6, greatly reducing dissolution of environmental PbS and/or soil-Pb. Limestone in soil or mine wastes, or higher cation exchange capacity neutral pH soils might consume gastric acidity and thus allow the digesta to enter the small intestine without receiving the strong acid attack normally assumed to take place in the stomach.

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VII. RISK MANAGEMENT

A. Risk Assessment/Management

The overall analysis of risk due to an environmental contaminant has been systematized by the National Academy of Sciences (NAS, 1983). In this approach, the risk assessment is composed of two parts; namely, hazard assessment and exposure assessment. Associated with the risk assessment in the overall analysis is the area of risk management. The main focus of the present discussion is on exposure assessment and in particular development of a relationship between blood lead levels and the levels of lead in soil as one possible source of exposure.

The objective of this analysis is a suggested soil lead guidance based on the relationship between levels of lead in soil and the results of blood lead levels. This relationship forms part of the exposure assessment. Other parts of the exposure assessment include contributions to blood lead levels due to dust, water, food, paint and other sources. The overall exposure assessment includes all these potential sources.

The specific blood lead level at which there is a health concern is a matter of present debate in the public health community as discussed in detail in a previous section of this report. As consensus develops concerning a specific number, this allows the suggested soil lead guidance to be scaled accordingly.

The overall risk assessment can be achieved on a site specific or case-by-case basis. If the major exposure route is from the soil then the suggested guidance developed here can be applied directly to determine clean up levels.

Risk management has several inputs. One is the risk assessment as previously described. In this case the limited question of the relationship between blood lead levels and soil lead concentration is considered. However, it must be recognized that in deciding on clean up strategies, several other factors impinge on the decision process. Other aspects of the risk assessment can change the decision such as the use of different blood lead levels of concern from the hazard assessment and exposures to lead from sources other than soil. Several other factors are involved in the risk management decision process; viz, economic, legal, political and social. It is not the purpose of the current analysis to address these other aspects, only to note their existence.

The area of risk assessment has been addressed by the Federal Government (1983) Hallenbeck, et al. (1986), Ricci (1985) and Rowe (1977) which may also serve as suggested reference material.

B. Risk Communication

There are three methodologies concerned with estimating risk: risk assessment, risk management and risk communication. Prior to 1986 there was little literature on the subject of risk communication. Since that time many articles have appeared and conferences and special sessions have been conducted on this topic. The importance of this methodology is in the increasing awareness of dissonances and tensions between the risk assessment experts and the lay communities. Risk communication represents a new policy focus that addresses the problem of the divergence

between expert approaches and lay perceptions of risk. The broad question that underlies this subject is; how can experts and the general public communicate about uncertain environmental hazards in a manner that both educates the public, informs the experts and respects the democratic process. Risk communication has been discussed by Davies (1987) and Covello, et al (1988) along with Guidebooks (1986); Community dialogue (1988) and perceptions of risk (1980).

A number of factors can contribute to the trust and confidence that can be established by a successful risk communication program. These factors include; consistency in the risk estimate message and in the people communicating this message, independent corroboration of the risk assessments by external scientific advisory boards, easy public access to official regulatory agency information and data, understanding inconsistencies between scientific and popular views, not to assume that good risk communication correlates directly with a change in behavior and collaboration between federal, state and local agencies.

A number of often incorrect and unspoken assumptions underlie the view some take to risk communication. Too often it is assumed that the risk assessment is done well and without bias and that such an assessment will lead all honorable experts to the same conclusions. Often it is assumed that the non-technical concerns of the lay public (fairness, local control, courtesy, property values and moral values to name a few) are irrelevant or of secondary concern and that therefore risk communication can be

one-dimensional and technical instead of being (more realistically) multidimensional and value laden.

C. Uncertainties and Non-technical Considerations

Among the numerous technical and non-technical factors that need to be considered by the risk manager are the number and age of the exposed population. If the location of concern contains low income housing, school yards, or playgrounds, the issue is far more significant than if the area of concern contains factories, retirement communities or warehouses. The decision maker needs to consider present and probable future land use in deciding whether to act and if so what kind of remedial effort is required.

It is also important to recognize the probabilistic nature of this problem. While it is possible that 300 ppm lead in a soil may present a health problem to some children, it is more likely that 1500 ppm will present a problem. Numerous factors such as the percentage of bare soil present; the number, age and ethnicity of the children; and the social-economic status of the residents determine the extent of the problem. There are many areas that have soil leads greater than 1000 ppm. It is important to begin cleaning up the largest number of areas containing the high risk children and the highest lead contamination. These are mostly the inner cities where soil leads are high because of the past use of lead-based paint and leaded gasoline coupled with more low income minority children.

While the bulk of this document concerns itself with scientific and technical issues, it is clear that many legal,

political, social and economic aspects are important factors. Indeed, in many cases, these will be the deciding factors on remedial actions.

There is always uncertainty in the scientific and technical data and models. This uncertainty will leave the decision maker (risk manager) without an absolutely accurate assessment of the risk. In many cases, the uncertainty will be so great that policy decisions regarding the appropriate margin of safety, the feasibility remediation and the ultimate cost of clean-up will be the over-riding factors in the decision. In these cases risk communication will play an even more important part in the process than usual.

1. Geographic and Physical Processes that Affect Soil Lead Accumulation

Thorough understanding of the fundamental mechanisms involved in soil accumulations of lead assist in describing the relationship between various types of lead sources and the responses of the population to these sources. The strong relationship between blood lead and soil lead has been well-described for a number of different populations living in a variety of socio-economic conditions. The most at risk populations show the strongest relationship, but the relationship is strong even for the least exposed middle to upper middle class children living in a suburban situation (Rabinovitch and Bellinger 1988). There are several key features that assist with understanding the geographic distribution of lead in soil.

a. Rural Background Lead

The lead content of unmineralized soils is well below 150 ppm within the rural setting. In the U.S., a major survey of rural soils revealed a geometric mean of less than 20 ppm. In studies where special efforts were made to collect soil samples which were insulated from highways, industries and other sources of lead, the lead content measured 5 to 10 ppm and even lower. In mineralized soils, the background levels of natural soil is around 150 ppm. Against this background lead there are various types of lead sources that have caused the accumulation of lead. See Table 14.

The two major sources of lead (excluding its use as an insecticide) that have accumulated in the urban environment have been derived either from paint or emitted as an aerosol from smoke stacks or automobile exhaust and become deposited into the soil. Figure 3 illustrates the history of lead usage from 1910 to 1989.

Soil that has been contaminated with paint was either within close proximity to a painted surface that has deteriorated, or secondarily, polluted from the disposal of materials (wood and metal) that was covered by leaded paint. Soil contaminated by aerosols, as described below, have become dispersed in a far more complex manner. The aerosol sources will be described in terms of the geographic patterns of lead accumulation that they impose upon the environment. There are three types of aerosol sources of lead that can be described in terms of their geographic characteristics, (1) point sources (2) linear sources and (3) area sources.

Table 14

Distribution of lead contents of soils
from England, Wales, and the United States

Percentile	Data Source*		
	Wales(654)+	England(1774)	U.S.(3305)++
kg ⁻¹ -----			-----mg
0.1	1.3	5	0.2
10	13	12	-
50	34	45	11
95	211	168	26
99.4	3,369	16,400	4,109

*Number of samples appears in parentheses.

+Collected from sites on a regular 5-km grid over all of Wales and all of England.

++Collected from major crop producing regions on sites removed from point and mobile sources of contamination.

Pb USAGE (TONS x 1000)

DATA

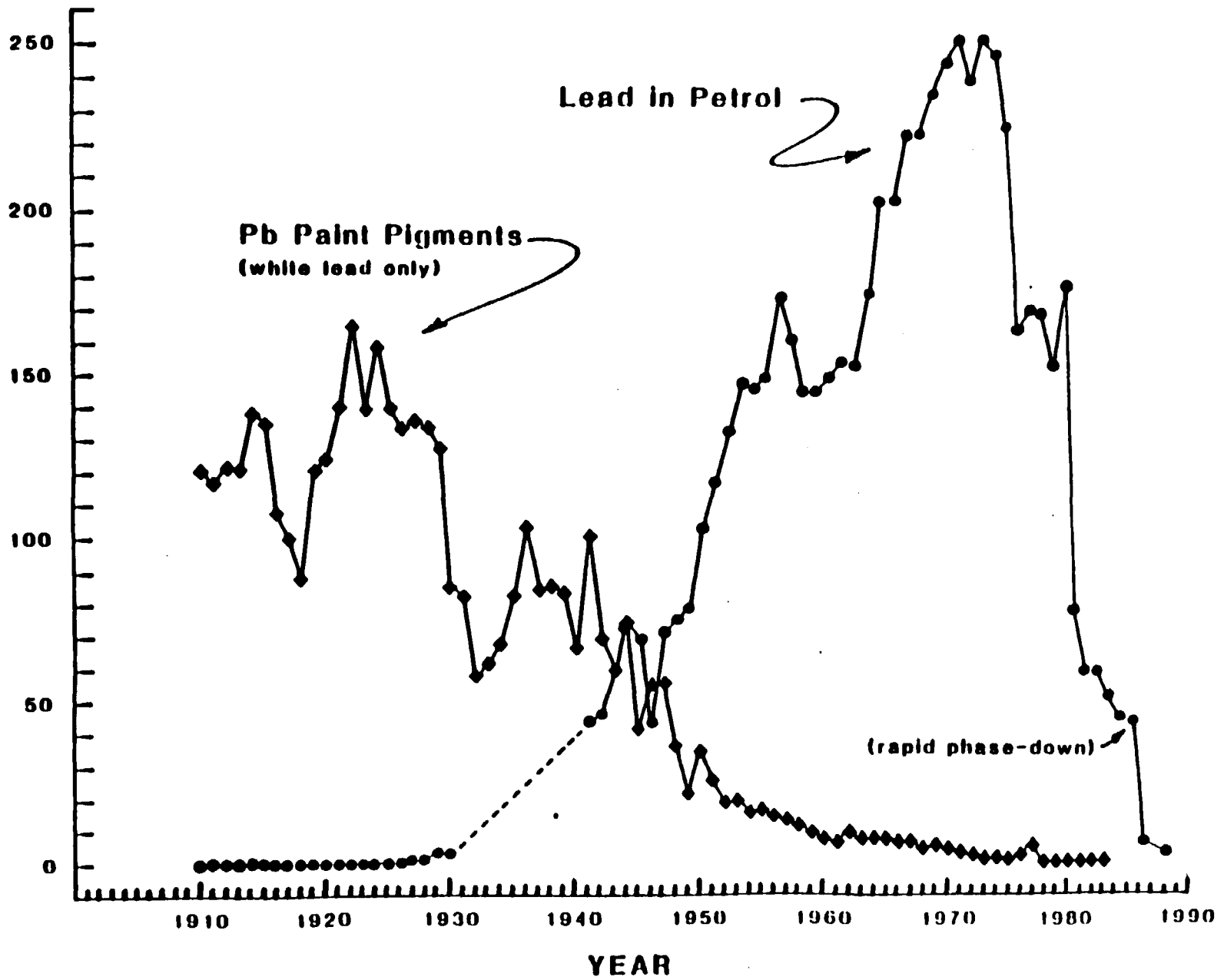


Figure 3: Lead Usage from 1910-1989

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b. Point Sources

The Point Source delivers lead into the environment from a single site. A smoke stack of a primary lead smelter may be an example of a point source. The pattern of lead distribution around a smoke stack is influenced by two main features, (a) the physical characteristics of the lead particles as they are emitted from the smoke stack and (b) the stack height and prevailing meteorological conditions which carry the emitted particles and disperse them across the landscape. The distribution of lead around point sources is well known. The lead concentrations are highest near a point source and decrease as a log function of distance away from the source. There are several phenomena operating to cause the rapid decrease with distance. For example, particle size is very important. Large particles tend to fall out relatively quickly and smaller particles become entrained in the air stream and can be carried great distances. Also, the geometry of dispersion is important. As distance increases from a point source, area increases at a geometric rate. This process also results in the dilution of lead particles in a manner that is a function of distance. The pattern of lead accumulation resulting from the above processes is a series of more or less concentric rings with concentration decreasing away from the point source.

c. Line Sources

When a point is moved across a plane it forms a line. The Line Source of lead is associated with automobile emissions and traffic flows. Lead emissions from automobiles resulted from th

use of lead as an octane booster in gasoline. Until recently, many thousands of tons of lead were used as an additive to gasoline each year. U. S. use peaked at over 200,000 metric tons per year in 1970. Many studies have been conducted on the lead distribution pattern associated with highways. Lead accumulations are highest along busy highways and lowest along infrequently traveled roads. As with point sources, in a rural area there is a rapid decrease of lead with increasing distance from the highway.

Because of the amount of lead used which may be accumulated as dust, the gasoline source is especially important to consider in detail. About 75% of the lead added to gasoline was emitted from the exhaust pipe and the remaining lead was deposited in the oil or in the muffler and tail pipe of the exhaust system. About half of the lead is contained in particles of sufficient mass that are deposited within several tens of meters from the highway. The other half of the lead emitted as exhaust is contained in very fine particles that may become entrained in air. The entrained aerosol particles are then removed from the atmosphere through washout, deposition and impaction. Lead aerosols are widely dispersed. Some portion is deposited in sediment basins and glacial ice at remote places. Impaction explains the occurrence of lead on tree limbs and leaves even in the most remote areas. Impaction takes place on any verticle surface. Although lead in gasoline has been dramatically reduced in recent years in the U.S. and other industrialized nations, the accumulation of lead along highways remains as a legacy of the

use of lead as an additive to gasoline during the past 50 years or so.

d. Area Sources

When a line is moved perpendicularly across a plane it demarks an area. There are no true primary Area Sources of lead. However, waste dumps created from mill tailings (the material left over from the concentration of ores extracted by mining) and other secondary area sources are examples of this type. This material can be dispersed by wind and water erosion. Often the sandy nature of tailings material make these waste piles attractive recreation areas for dirt biking and other activities that bring children in contact with the contaminated material.

The modern industrial city is composed of a complex combination of point sources and linear sources of lead which are unevenly spread over an area. The uneven distribution causes the lead content of urban soils to have a very distinctive pattern. Large cities have more accumulated lead than small towns of the same age. Within a given city, the amount of lead that has accumulated is usually highest in the neighborhoods near the center of the city and lowest in outlying neighborhoods. This pattern holds up even when the ages of the neighborhoods are similar. Old neighborhoods in outlying areas have significantly lower amounts of lead than similar aged neighborhoods located toward the center of the same city.

The basic patterns of soil lead in various urban environments match those described for the lead exposure of the population. The congruence between the soil lead and blood lead

matches what has been learned about the relationship between soil lead and blood lead for children. The congruence between soil as an environmental measure and the exposure response by childhood populations provides planners and policy makers with an important tool for defining critical sites, and for setting priorities for undertaking cost efficient amelioration of excessive lead exposure of children.

2. Uncertainties

It should be clear from the above discussion that the patterns of lead are very complex within the urban environment. What is known is that soil lead and blood lead are strongly related. But is also known that the increase of blood lead per increase in the content of lead in soil varies for different populations. The least exposed cleaner and well-maintained environments, experience a small increase per increment increase of lead in soil (less than 1 $\mu\text{g}/\text{dl}$ / 1000 ppm soil for the least exposed upper middle class suburban children according to Rabinovitch and Bellinger, 1988). The most exposed children exhibit a larger increase in blood lead per increment increase in lead in soil. Several studies have found levels of about 5-10 $\mu\text{g}/\text{dl}$ / 1000 ppm (Angle and McIntyre 1982, Bornschein, et al 1986, Brunekrief, et al 1983) for the most exposed children. The greater sensitivity of the most exposed children is probably a function of the poor conditions of the environment (bare soils and play areas next to buildings), low nutritional status (especially low calcium and iron status), and perhaps an overall difficulty with supervision in a lead contaminated environment.

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It has been observed that the most exposed children have behavioral characteristics that make them hard to discipline. Their lead exposure predisposes them to lower quality of parental supervision (Dieterich et al 1987).

The major uncertainty is how to proceed with amelioration. The above information provides some important guidance as to what can be done. Given the different rates of exposure in different places (ie, the inner-city has a greater rate of exposure than suburban or rural areas) it should be clear that by focusing attention on those urban places that have the greatest content of lead will provide the largest amelioration benefit per unit expense of cleanup cost. Mapping the soil lead levels in the countryside and major cities (Davis et al 1984, and Mielke et al 1989) can delineate those areas of greatest and immediate concern. There are many uncertainties concerning how to proceed with lead prevention. For example, deleading homes seemed like a good idea. But, because of the dust it generates, without thorough cleanup afterward, it is not effective in preventing lead exposure to populations of young children. Demonstration programs are needed to develop and test lead exposure prevention methods. There are several methods that should assist children. For example, if small particles are a major component of the problem, then the use of high efficiency vacuum cleaners (ULPA and HEPA) should reduce lead burdens from dust accumulations in homes of neighborhoods with the highest lead content; improving the nutrition of the children who are most exposed should reduce their physiological response to lead. These approaches would be

relatively inexpensive. Some of the most contaminated urban neighborhoods may need out-right soil removal and replacement in order to reduce the risk of lead exposure from soil and dust to acceptable levels. Other places may only need some resodding or grass seed in order to reduce lead levels to acceptable levels. Most non inner-city and small town neighborhoods probably to not need any work at all.

All people should benefit from carefully prepared and well-focused education about the lead problem. But herein lies a problem. The needs of a neighborhood must be matched to the reality of the fact that there is not simply a single lead problem, rather there is a multi-dimensional lead problem. The problem is further confounded by the divergent cultural makeup of society and the complicated environmental lead patterns of the neighborhoods of our modern urban society. Solving the lead exposure problem requires a number of approaches. It is important to be able to determine what methods are most effective as options for various types of neighborhoods as lead prevention becomes part of public programs.

3. Behavioral/Social Aspects of Lead Poisoning

The principal concern with respect to dust/soil lead is the young (6-72 months) child who inadvertently (or purposefully) ingests contaminated dust and/or soil. Clearly there are many social/economic/behavioral parameters that can increase the extent of exposure through hand-to-mouth activity in the child. These include the degree of cleanliness of the environment, the frequency of hand-to-mouth activity, the extent of parental

supervision, the extent of contamination, and the extent to which absorption can be affected by factors such as nutritional status.

While much remains to be understood about these interactions, there is a considerable amount of information available that gives insight on this complicated problem.

a. Social/Economic Characteristics as Factors in Risk

A recent study by Pope(1986) estimates that the percentages of housing by year of construction having paint with lead greater than or equal to 0.7 mg/cm^2 as: pre-1940, 99%; 1940-1959, 70%; and 1960-1975, 20%. Of particular interest are those homes containing lead-based paint which are not in good repair. Chisholm, et al. (1985) and Clark, et al. (1986) have shown that deteriorated housing has a very significant effect (as much as a doubling) on blood lead levels in young children. Clearly, deteriorated older housing stock will tend to be located in the poorer areas of the central cities.

The expectation of greater lead exposure to lower SES (Social Economic Status) children is supported by the NHANES II survey (1982) which found that the prevalence of blood lead levels greater than $30 \text{ } \mu\text{g/dl}$ in 6 to 60 month old children in families with an annual income less than \$6000 was nearly 10 times higher in families with an annual income greater than \$15,000. Other investigators such as Bornschein, et al.(1985) have demonstrated the influence of educational background and degree of parental care on childhood blood lead levels.

It is quite likely that several factors contribute to the increased exposure of poor children to lead. Not only is there a

higher incidence of dilapidated older housing, but there is also a tendency to find low income housing areas near busy central city streets(Mielke, et.al., 1985) and there is a higher incidence of nutritional deficiencies that are associated with increased lead absorption by children.(Yip, et.al., 1981) In addition, factors such as an increased incidence of working single parents and accompanying poorer supervision because of poorer access to day care may contribute to the greater risk to low-income children. Occupations of adults can also result in added exposure of children to lead. For example, contaminations of the home can occur from adults with lead dust on their clothing from lead related jobs.(NAS, 1980, Rice, et al., 1978)

b. Ethnicity as a Risk Factor

The NHANES II data also exhibited a dramatic difference in lead exposure between white and black children. The rate of exposure of black children is 2-4 times greater than white children between 6 and 60 months of age at blood leads over 30 $\mu\text{g}/\text{dl}$. The situation for Hispanic children is less clear because the NHANES II data could not distinguish this group. A survey in New York found that Hispanic children were intermediate to white (Anglo) and black children in blood lead concentration. (Billick, et al., 1979)

Because the NHANES II survey was not designed to distinguish Hispanics from Anglos and blacks, the Hispanic Health and Nutrition Examination Survey (NHANES) was conducted in 1982 to 1984. (Carter, et al., 1989) This survey distinguished children of Mexican-American ancestry from those of Puerto Rican and Cuban

ancestry. It also distinguished children of Mexican-American ancestry born in Mexico from those not born in Mexico. Unfortunately, because of the downward trend of blood lead levels (ATSDR, 1988) it is not possible to compare these groups with Anglos and blacks, but they can be compared to each other. In general, Puerto Rican children living in New York were at greater risk than the other subpopulations. Mexican-American children born in Mexico were found to have higher blood lead levels than those born in the U.S.

Various social-economic indicators were also found to be significant in the HISPANIC NHANES study. Mean blood lead levels for Mexican-American and Puerto Rican children were highest for those children living in the central cities in families with the lowest annual incomes and education of head of household. Puerto Rican children living with a married head of household had lower mean blood lead levels than did children living with a single head of household.

It is possible that the ethnic background is simply a surrogate for a number of social/economic/cultural factors. The high proportion of Puerto Ricans who live in poverty (42%) may be the driving factor that contributes the exposure through a combination of intercity neighborhoods, old dilapidated housing, poor nutrition, inadequate supervision (lack of day-care, etc.) and other factors that can be attributed to poverty. In the same regard, Mexican-American children living in the Southwest have a 23% poverty rate compared to only 11% for all persons of non-Hispanic origin.

Thus, screening, investigation and remedial programs should focus first on areas in the central cities with high populations of black and Puerto Rican children.

c. Age Distribution

Numerous studies have shown that urban children, particularly those of pre-school age (less than 5 years) are the sub-population most at risk (Mahaffey, 1982, Carter, 1989, ATSDR, 1988). As noted by the ATSDR report (1989), the precise age interval for children at greatest risk has not been defined. Because the exposure begins prenatally there is, in general, not a lower bound on the age. Since this report, concentrates on lead in dust and soil, it seems reasonable to assume that infants and toddlers will be a greatest risk from contaminated soils and dusts. The NHANES II study showed that 6 to 24 month old children had higher blood lead levels than 36 to 60 month children who in turn had higher blood lead levels than those older than 60 months.

d. Gender

The NHANES II study found that the percentage of elevated blood lead levels was slightly higher among boys than girls but this difference was not significant (Mahaffey, et al 1982). In the HISPANIC NHANES study Mexican-American males had a statistically significantly higher mean blood lead level and a nonstatistically significantly higher percent elevated blood lead than did Mexican-American females (Carter, et al 1989).

At this point there does not seem to be a strong reason to include gender as a risk factor.

e. Customs and Mores

In the Mexican-Hispanic and Hmong Cultures, folk remedies are often the cause of high blood lead levels and lead poisoning in children. Azaran and greta are fine powders with total lead contents varying from 70% to greater than 90%. They are often used by Mexican-Hispanics to treat children under 12 years of age for gastrointestinal illness. Hmong parents use a folk remedy referred to as "pay-loo-ah" to treat infants and children for rash and fevers. The remedy consists of red and orange powders with a lead concentration of 8%. Although there have been extensive educational programs directed towards Hispanic and Hmong families publicizing the dangers of these folk remedies, customs of use may still be retained in certain families and should be taken into consideration in any type of study or assessment (MMWR, 1983, MMWR, 1983a).

f. Educational Background

Presumably, the educational background of concern is that of the parents. Because this is highly correlated with, and part of, social-economic status, there is an overlap with the discussion in Paragraph 1 of this section. The NHANES II results do not give any insight on the importance of parental education. The HISPANIC NHANES (Carter, et. al, 1988) data did show a significantly lower blood lead for Mexican-American children whose parents had a higher level of education.

Since this factor interacts strongly with those involved in Social-Economics factors there does not seem to be a strong reason for considering it separately.

4. Legal Aspects

a. Currently, there is not a national policy for cleanup of lead in soil.

1) EPA has established no reference dose (RFD), or other level, setting an acceptable daily intake for lead. Accordingly, the various EPA regions experience great difficulty in completing risk assessments for lead-contaminated sites.

2) In the absence of a national standard, EPA regions reach inconsistent decisions on appropriate cleanup levels.

3) The EPA Office of Solid Waste & Emergency Response (OSWER) currently advises the regions to use the Centers for Disease Control (CDC) guidance of 500 to 1000 parts per million for cleanup decisions. (Inside EPA, Jan. 20, 1989, p. 15).

b. Other lead levels have been established, and may be considered during remedial activity.

1) Occupational Safety and Health Act (OSHA) Air Contaminant Levels.

a) Action level - $30 \mu\text{g}/\text{m}^3$ (averaged over an 8-hour period).

b) Permissible Exposure Limit (PEL) - $50 \mu\text{g}/\text{m}^3$ (averaged over an 8-hour period).

c) OSHA is designed to protect workers in a closed environment (e.g., a building).

2) Clean Air Act (CAA).

a) National primary and secondary ambient air quality standards for lead: $1.5 \mu\text{g}/\text{m}^3$ (maximum arithmetic mean averaged over a calendar quarter).

- b) Different emission limitations can be placed on each source of air pollution. (see e.g., 40 CFR Part 60).
 - c) States may adopt additional and more stringent limitations.
- 3) Clean water act (CWA).
- a) National Primary Drinking Water Regulations (Maximum Contaminant Levels - MCLs): 0.05 mg/l for lead.
 - b) On August 18, 1988, EPA proposed regulations which would place the MCL for lead at 0.005 mg/l, and the MCL goal (MCLG) at zero.
 - c) Differenc effluent limitations can be placed on each source of discharge into waters of the United States. (See, e.g., 40 CFR Part 433).
 - d) States may adopt additional and more stringent standards.

5. Cleanup Levels for Lead

The EPA has not established a reference dose (RfD), or other level, which would set an acceptable daily intake for lead. As a result, the various EPA regions have experienced great difficulty in completing risk assessments for lead-contaminated sites. The absence of a national standard has resulted in inconsistent decisions on appropriate cleanup levels from the different EPA regions. This inconsistency has prompted the EPA's Office of Solid Waste and Emergency Response (OSWER) to advise the regions

to use the Centers for Disease Control (CDC) guidance of 500 to 1000 parts per million for cleanup decisions (Inside EPA, Jan. 20, 1989, p. 15).

Although there is as of yet no national policy, other lead levels have been established and may be considered during remedial activities.

The Occupational Safety and Health Act (OSHA) Air Contaminant Levels were designed to protect workers in closed environments such as buildings. OSHA has set an Action level at $30 \mu\text{g}/\text{m}^3$ (averaged over an 8-hour period), and a Permissible Exposure Limit (PEL) of $50 \mu\text{g}/\text{m}^3$ also averaged over an 8-hour period.

The Clean Air Act (CAA) has set a national primary and secondary ambient air quality standards for lead at $1.5 \mu\text{g}/\text{m}^3$ with the maximum arithmetic mean averaged over a calendar quarter ("ambient air" is the portion of the atmosphere, external to buildings, to which the general public has access). The CAA allows for different emission limitations to be placed on each source of air pollution (see e.g. 40CFR Part 60). The Clean Air Act also stipulates that individual states may adopt additional and more stringent limitations.

The Clean Water Act (CWA) has set National Primary Drinking Water Regulations (Maximum Contaminant Levels - MCLs) at 0.05 mg/l for lead. However, on August 18, 1988, the EPA proposed regulations which would place the MCL for lead at 0.005 mg/l, and the MCL goal (MCLG) at zero. The CWA allows for different effluent limitations to be placed on each source of discharge

into waters in the United States (see e.g. 40 CFR Part 433). The Clean Water Act also enables individual states to adopt additional and more stringent standards.

6. Potential Liability in Establishing Cleanup Levels

A small risk of liability exists if a person is injured at a "cleaned up" lead-contaminated site, and that injury can be traced to excessive lead concentrations remaining in the soil. However, the lawsuit potential can be reduced if a few precautions are taken. To begin with, the most likely basis of action is negligence, defined as "...the failure to observe, for the protection of the interests of another person, that degree of care, precaution, and vigilance which the circumstances justly demand, whereby such other person suffers injury." Therefore, the responsible party should make every attempt to assimilate all available studies and make an informed, scientific judgement based on those findings. This will insure that the responsible party is utilizing "due care" in the determination. The investigation may find that "safe" lead levels will vary among contaminated sites, due to the differences in exposure potentials. This fact, and any other limiting data, should be included with the recommendations, so as to appropriately limit the scope of the findings.

A negligence cause of action would require a finding that the responsible party owed some duty to the suing party. This may be difficult to establish if: (1) no specific site is contemplated in establishing the guidelines, and (2) the

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recommendations emphasize that the necessary cleanup level may vary with each site, depending on potential exposures.

It should be noted that EPA and the States, under the current regulatory scheme, have the final authority to determine appropriate remedial levels. This determination - the Record of Decision (ROD) - must be made at each site. In addition, each ROD is published for public review and comment. By vesting final authority in the government, the process greatly reduces the likelihood that the responsible party would be held liable for excessive lead levels remaining after the remediation.

The most likely target of any lawsuit would be the government agency approving the cleanup level, and the parties who are responsible for the original contamination and/or subsequent cleanup of the site.

7. Economic Considerations in Establishing Lead Levels

After the remedial investigation (RI) is completed, a feasibility study (FS) is undertaken to develop and evaluate the remedial alternatives available at a particular site. Cost is considered at both the initial screening and detailed analysis stages of evaluation. Thus, during the initial screening of all alternatives developed in the FS, the cost of implementing the remedial action must be considered which includes the operation and maintenance costs. An alternative which far exceeds the costs of other alternatives, without providing a substantially greater measure of protection to the public's health or the environment, nor increased technical reliability, should be excluded from further consideration. Those alternatives which

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meet or exceed the appropriate Federal public health and environmental requirements (ARARs), are more desirable since they will provide greater protection than do those alternatives which do not meet such requirements.

After the initial screening, the remaining alternatives are evaluated in detail and the lead agency will select a "cost-effective remedial alternative" that properly mitigates and minimizes threats to human health and the environment. In choosing the appropriate alternative, the lead agency will consider "cost, technology, reliability," and other concerns, with regards to their relevant effects. Also, the lead agency will typically consider costs only among those plans which meet the designated ARARs, although there are some statutory exemptions.

Cost-benefit analysis is made on a case-by-case basis. There is currently no set formula or ratio to apply in determining what degree of cleanup, due to excessive cost, would be viewed as inefficient.

EPA proposed revisions to the National Contingency Plan (NCP) on December 21, 1988. Cost effectiveness is still to be considered in selecting a remedy, but only after the alternatives have been found to provide adequate protection of human health and the environment. The selected alternative must also comply with all designated ARARs, or provide grounds for invoking a waiver of an ARAR.

8. Economic and Financial Considerations Concerning Remedial Actions

Before determining the need for a remedial action, it is necessary to establish a scope of the available financial resources. Depending on the site's location, size, and uses, the contaminated site may be eligible to enlist community, state and federal resources to supplement private funds, thus, ensuring that all necessary cleanup actions may be taken.

The costs involved with the physical cleanup of the soil are not always the only ones incurred during a remedial action. Liabilities involved in taking or not taking action also play a significant role in determining the scope of the remedial action plan. The costs of monitoring a site after the cleanup has been completed should also be factored into the total cost of the remedial action.

Remedial action methods which require some form of soil treatment to reduce potential health risks include, but are not exclusive to, the following:

a. Soil Removal

As the name suggests, this method involves excavating all of the lead contaminated soil and transporting it to an approved site for disposal. Clean fill is brought in, where it is necessary, to replace the soil excavated at the contaminated site.

This method is sufficient for most sites and serves as one of the quickest measures to immediately reduce the threat to public health. However, if the volume of contaminated soil requiring excavation is large, this method can be extremely costly. Another important point to remember is that the soil

excavated from the site has not been decontaminated, but simply moved to another location and so it still contains unacceptable levels of the contaminating substance. (ICRCL 1987)

b. Soil Containment

Soil containment isolates the contaminated soil by covering it with new, clean soil or a hard cover. Hard cover is the preferred and more cost effective method of covering; however, to ensure that it works appropriately it must be well designed and properly installed and maintained. (ICRCL 1987)

A clean inert fill can be used so long as it is sufficiently thick to contain the contaminated material and results in a soil which has an acceptable lead concentration. This process should not mix the old contaminated soil with the new covering soil and ground cover should be reintroduced as soon as possible to prevent new soil erosion. (Elias 1988)

c. Contaminant Extraction: Soil Washing and Flushing

These methods involve chemically treating the contaminated soil and, while they are effective at removing metals, they can be quite costly. (ICRCL 1987)

To wash contaminated soil, it is excavated and mixed on-site with a chemical capable of removing lead. The liquid is then extracted and the clean soil returned to the site. The chemical-lead extraction fluid can be treated and the lead removed for re-use at another site. (Elias 1988)

Soil flushing is a technique which can be used when a contaminant has already reached the ground water. The process is applied directly to the soil's surface. The solution is then

given time to reach the groundwater. Once that has occurred, the groundwater is pumped up to the surface and treated. The clean groundwater is then reapplied to the soil surface. (Elias 1988)

This method is cost-effective since it eliminates soil removal and replacement costs; however, it may require several applications before the contaminants are removed. Furthermore, soil flushing is not a closed, contained process and, therefore, runs the risk of further contaminating the groundwater. Methods of modified soil flushing which are more controlled and contained have also been suggested and may prove useful in solving present limitations. (Elias 1988)

d. Deep Tilling

Instead of removing, covering or treating the contaminated soil, it can be tilled. Tilling mixes the contaminated soil with clean sub-soil, thereby reducing the lead levels on the surface. (ICRCL 1987) Tilling potentially reduces costs by eliminating the need for excavation and disposal; however, new costs may be incurred controlling drainage or erosion problems which may result. (Elias 1988).

e. Other Methods and Further Considerations

Revegetation of bare soils, community education, behavior modification, zoning, and vacuuming of dust within the house should all be considered as other methods of remedial action. The costs of these actions vary depending on the size of the population and the site itself.

After remediation has been completed, the site must be monitored to ensure the cleanup action remains effective. The

scale, duration, and cost of monitoring depends on the type of action taken. Finally, with time, the action should be assessed for future reference.

f. Costs of Not Doing Anything

The costs of undertaking a lead prevention project that is designed to reduce lead exposure is an expensive undertaking. Can society bear the cost of cleanup? Considering that lead paint removal and soil replacement costs thousands of dollars per home, the costs seem too much to bear. It is the intent of this section to consider some of the medical and remedial costs of lead exposure so that the price of not doing anything can be placed in perspective.

The costs of excessive lead exposure are only partially quantifiable. For example, the costs to society of permanently limiting the potential of a child cannot be known. What can be known are some of the treatment and remedial costs associated with the most extreme forms of lead exposure.

An evaluation of some of the costs of lead poisoning were undertaken by Povenzano, 1980, the EPA 1985, and Szako and Pollack, 1987. The later document provides estimated costs for the average medical and remedial education costs attributable to child lead poisoning in Massachusetts. In 1986, the estimated average medical cost is \$2,400 and estimated cost of remedial education is \$3,100 per lead poisoned child in Massachusetts. At \$5,500 per lead poisoned child, in Massachusetts about \$11 million is spent for the 2000 new lead poisoning cases which are found each year.

It is important to underscore what the above costs do not include. They do not include speech, physical and occupational therapy needed for many of these children. They do not include the extra costs in education (national average of about \$5,000 per pupil per year) for repeating grades in school that are often required by these children. The above costs do not include those incurred by a far larger group of children who may be experiencing adverse effects as a result of other levels of lead exposure. For example, exposure levels of 15 $\mu\text{g}/\text{dl}$ and even lower are now recognized as being associated with learning and behavioral deficits and the costs of assisting this group of children are not included in the above costs. The costs incurred as a result of excessive lead exposure are so large that there are enormous benefits to society for expending efforts to prevent this problem.

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SUPPLEMENT I

RECOMMENDED METHODS FOR SOIL SAMPLING FOLLOWING PROPOSED INTERNATIONAL STANDARD

INTRODUCTION

Soil is the uppermost layer of the Earth's crust, composed of solid particles and usually containing either or both water and air in the pore space. The topsoil often contains organic matter and microorganisms and is a possible plant site. The soil lying directly above the unweathered rock or sediment material is called solum.

In the context of soil protection the following should also be considered as belonging to the soil:

- ~~underground~~ ?
- raw material deposits
- anthropogenically influenced soil
- special defined areas (e.g. building areas, areas reserved for traffic, leisure and recreational areas, fallow land) (taken from ISO...)

Depending on its composition, structure and usage a soil may accumulate contaminants.

Contaminants are transported into the soil via air and water or as a liquid or solid input.

Adverse effects to natural soils may arise if the release into the soil or the level of secondary changes of substances in the soil is greater than the capacity of the soil to decompose the polluting substances, or if the material input is greater than the output. Natural background values may cause significant preconcentrations.

Soil may accumulate, change or shift contaminants for years and even may release them again.

Depending on the type of soil higher concentrations of substances, natural or contaminant, may need be taken into consideration. It is known for the heavy metals that they may show higher concentrations related to clay content or soil organic matter.

It is important to monitor both background and increased values.

A. Exploration strategy

1. Scope

This international Standard sets out the general principles to be applied in drafting sampling programs aimed at quality control, quality characterization, and identification of sources soil pollution. Detailed instructions for specific sampling situations will be given in subsequent International Standards.

Sampling of soil material aims at obtaining material of representative composition for analytical determinations.

In agreement with the investigating laboratory sampling has to be adjusted to the aims of the survey (physical, chemical or biological) or to other requirements (e.g. layers, mapping of lateral profiles, quality tests, investigation by labs).

Since the quality and value of the analytical testing results will depend upon the accuracy of the sampling, it is necessary that the samples collected should be reliable and representative of their particular location. This will necessitate that a great deal of care is exercised in determining where and how samples are collected.

2. Fundamentals of Optimization

Design of the sampling grid and number of sampling points should be optimal with respect to technical and financial considerations.

During the initial stage and particularly in the case of possible contamination, the following points should be dealt with systematically and be monitored:

- the type and nature of expected contamination
- knowledge of processes or possible sources of contamination
- available data on the area (geologic and hydrologic situation, kind of use)
- mapping of the area (including future development)

These data will serve as a basis for an optimal sampling strategy in order to:

- determine the nature of the contamination
- reconstruct the distribution pattern of concentrations in the soil
- localize the source of contamination
- qualify and quantify manner and degrees of accumulation and the bonding of contaminants in the soil, or of their release into the environment (air, groundwater, plants, animal, man)
- determine ~~of~~ soil quality in general

3. Preliminary Investigation

This should cover the following points:

Geographic References

- state
- district
- municipality
- Census tract (U.S.)
- street (road, drive, etc.)
- x-coordinate
- y-coordinate
- altitude
- dimensions
- land utilization
- land register number
- legal position, ownership

Situation at the area to be investigated

- pre-sampling, special kinds of utilization and permits
- infra-structure, future reclamation
- canalization, drainage systems, surface runoff
- position of water tables
- slope and exposition
- population and size of city

In suspect areas

- basic (raw) materials, chemical, products
- waste materials
- period of production
- hazards, accidents
- manners of waste disposal
- permits
- highway density and traffic congestion
- inner city locations

4. Inventory of the Local Situation

This should be carried out by qualified personnel with experience of the type of site to be investigated.

Start by visiting the site.

The following documents may be helpful:

- topographic maps
- population map
- highway map
- geological and pedological maps from geological surveys
- maps of soil use

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- hydrological maps
- geochemical maps
- reference list of background values
- plant ecology maps
- aerial photographs and satellite imagery
- historical information like:
 - statements from employees
 - statements from (ex)neighbours
 - history of growth of city
 - statements from drivers of waste transports
 - drop out rates of high school children

Preliminary mapping of the specific situation serves as a base to delineate the area to be investigated as well as to estimate the possible distribution of potential sources of contamination such as places of specific production processes, waste dumps.

In addition, information on the general distribution (horizontally and vertically) of soil types, soil profiles and changes in their distribution should be collected at this stage (e.g. refer to geological survey or soil maps).

5. Sampling Pattern Techniques

General

The choice of sampling pattern will depend on the results of the preliminary, and also on the degree of homogeneity of the soil at the location of sampling.

Techniques

All pattern techniques are based upon the selection of sampling points. Information in between these sampling points is gained by interpolation. The degree of certainty of information will depend upon distance between the sampling points. The following examples demonstrate some established methods applied for an unbiased positioning of sampling sites.

a. Irregular Sampling and Circular Grids

Figure 4 illustrates a circular grid used for the survey of support areas.

b. Systematic Sampling (Regular Grids)

In many cases a regular grid is selected. Because there is a direct relationship between optimal distance between sampling points and the (estimated) dimension of the contamination (see preliminary investigation), spacing between sampling sites should not exceed the greatest (estimated) extent of the contamination.

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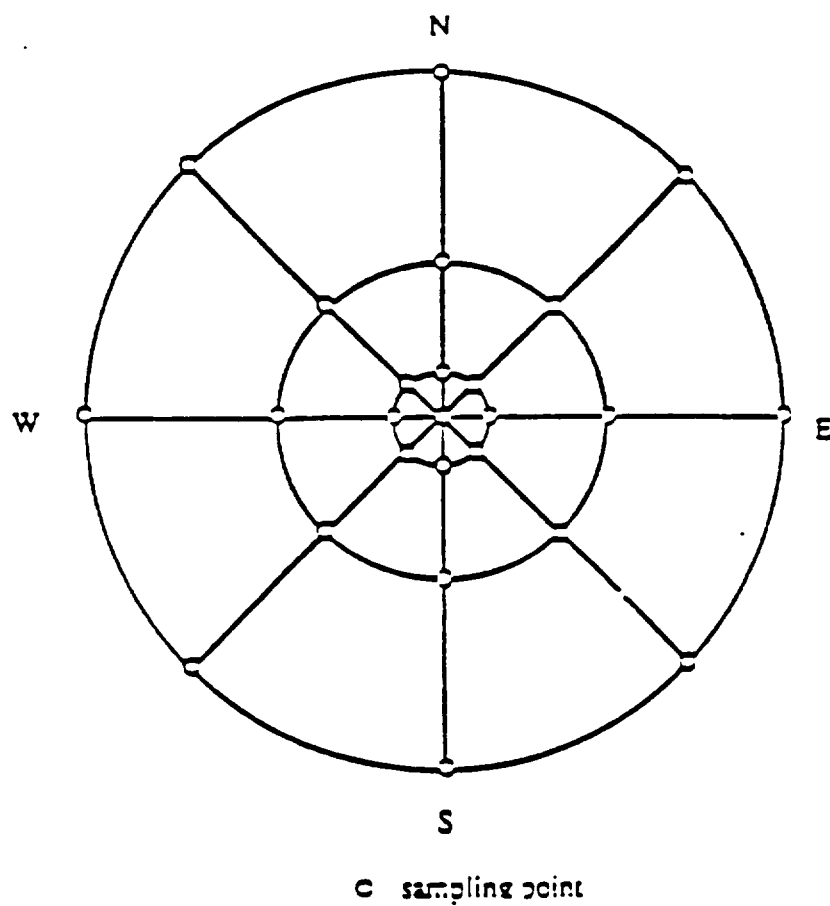


Figure 4: Circular Grid for the Survey of Suspect Areas

Grid dimensions will depend on how detailed the information has to be. The assigned spacing will differ according to purpose e.g. whether the aim is to collect samples of average degree of contamination, or the localization of isolated sources of contamination or to establish the extent of contaminated areas (horizontal) or zones (vertical). The latter attains particular importance in cases where a contamination is already located and a follow-up sampling program becomes necessary (Fig. 5).

Considering the pros and cons of a regular grid, it is an advantage that it may be set up easily and grid dimensions readily varied (Fig. 6).

c. Random Sampling

In cases of presumably spasmodic occurrences of contaminated zones random sampling could be applied. Sampling points within the area are selected by using random numbers which may be found in tables included in manuals on statistics or which may be generated. This technique has the disadvantage of irregular coverage and makes interpolation between sampling points difficult (Fig. 7).

d. Stratified Random Sampling

This method will avoid some disadvantages of random sampling. The site is divided into a number of grid cells, and a given number of randomly distributed sampling points is chosen each cell. The method has disadvantages in terms of interpolation. (Figure 8)

e. Unaligned Random Sampling

The term "unaligned" means "irregular" in the sense of "not-in-a-line".

This method is in keeping with stratified random sampling, but in this case only one of two coordinates is being chosen at random.

The procedure is as follows:

Example: Given a grid with 24 cells (squares), arranged in 4 lines and 6 columns (Fig. 9).

- (1) For the first cell (line 1, row 1) x- and y-coordinates are chosen at random.
- (2) For cells 2,3,4,5 and 6 only the y-coordinates are chosen at random.
- (3) For cells 7,13 and 19 only the x-coordinates are chosen at random.

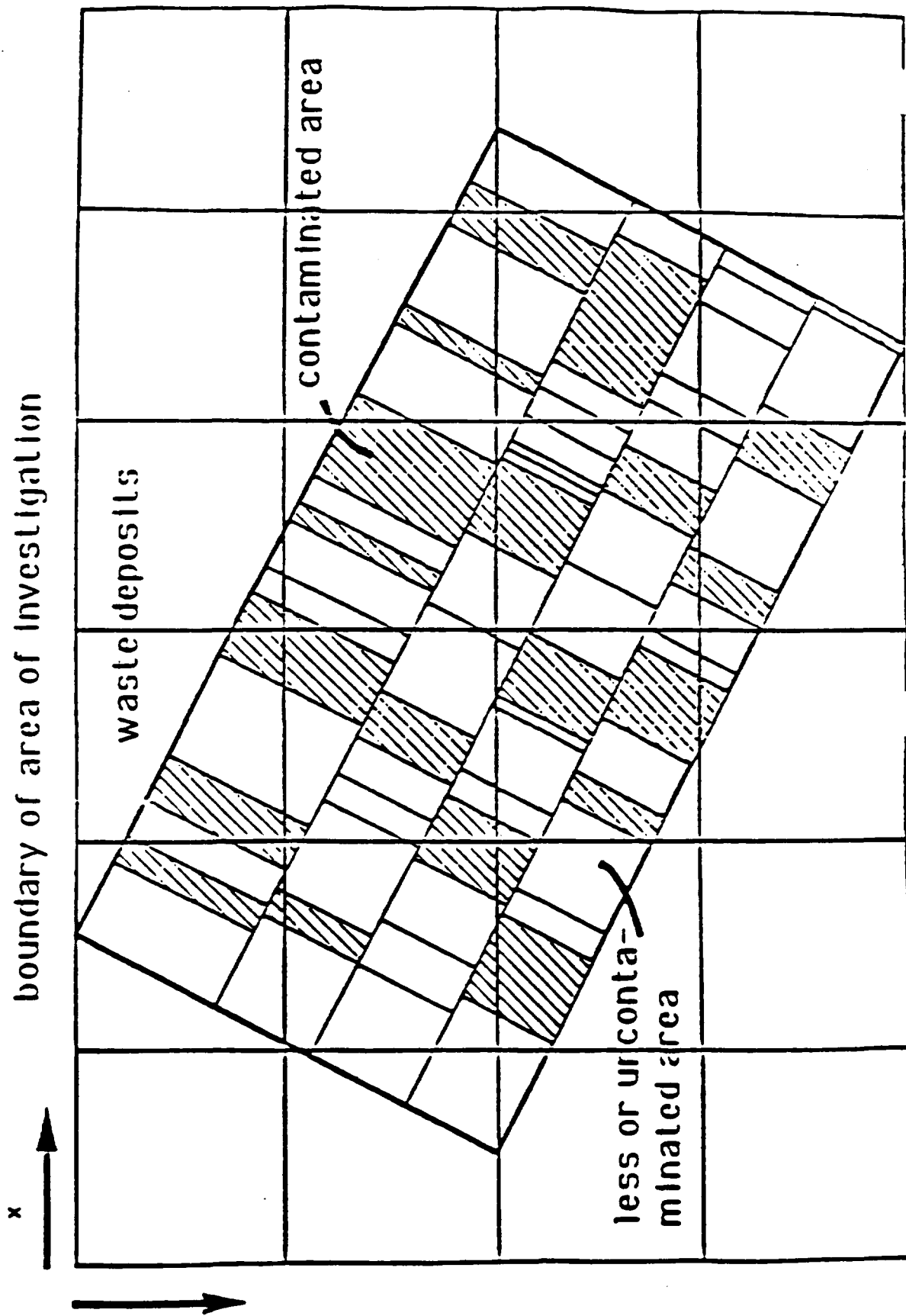
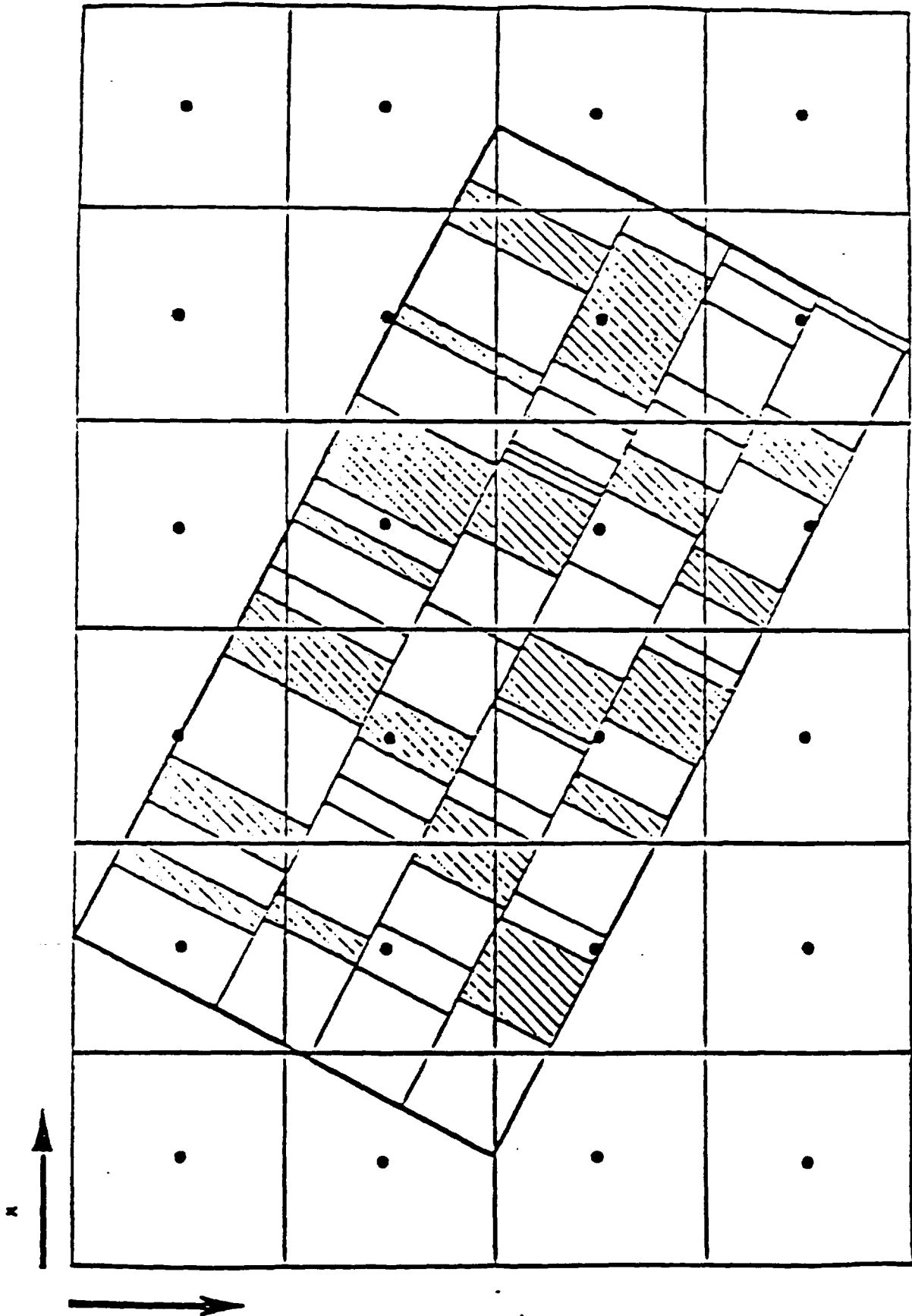


Figure 5: Example of Soil Contamination



> Figure 6: Regular Distribution of Sampling Points on a Regular Grid

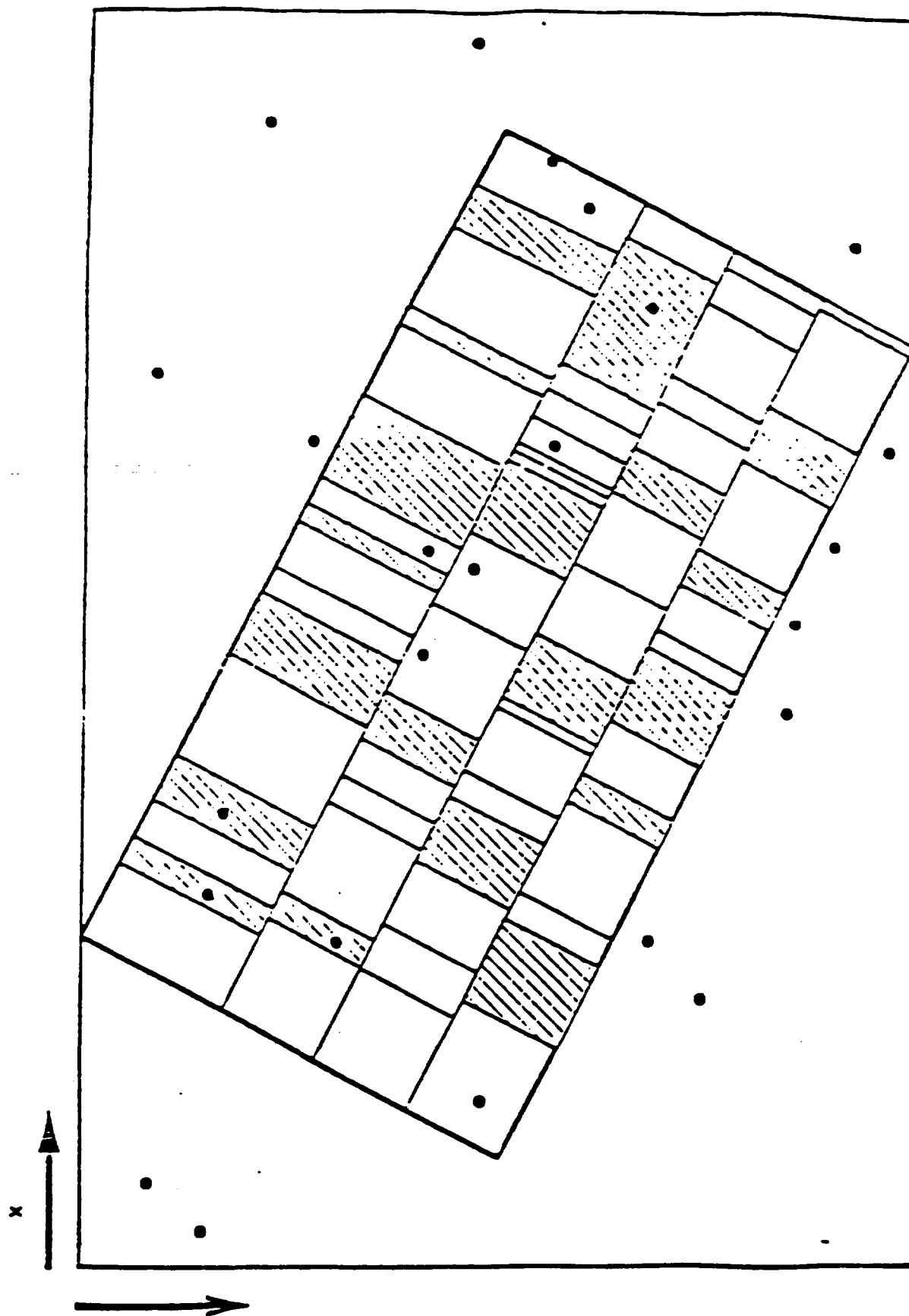


Figure 7: Random Sampling Without Grid

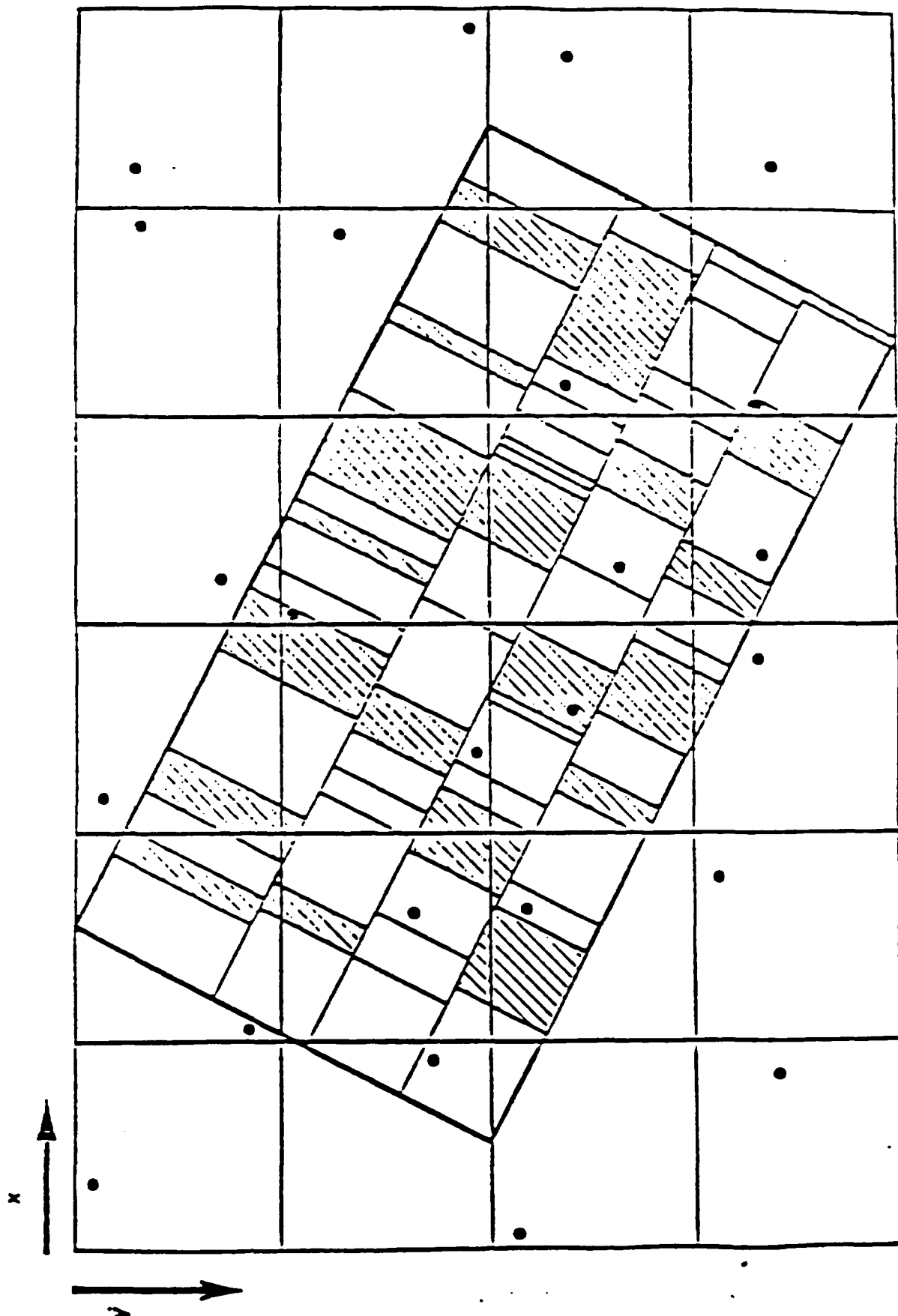


Figure 8: Stratified Random Sampling on a Regular Grid

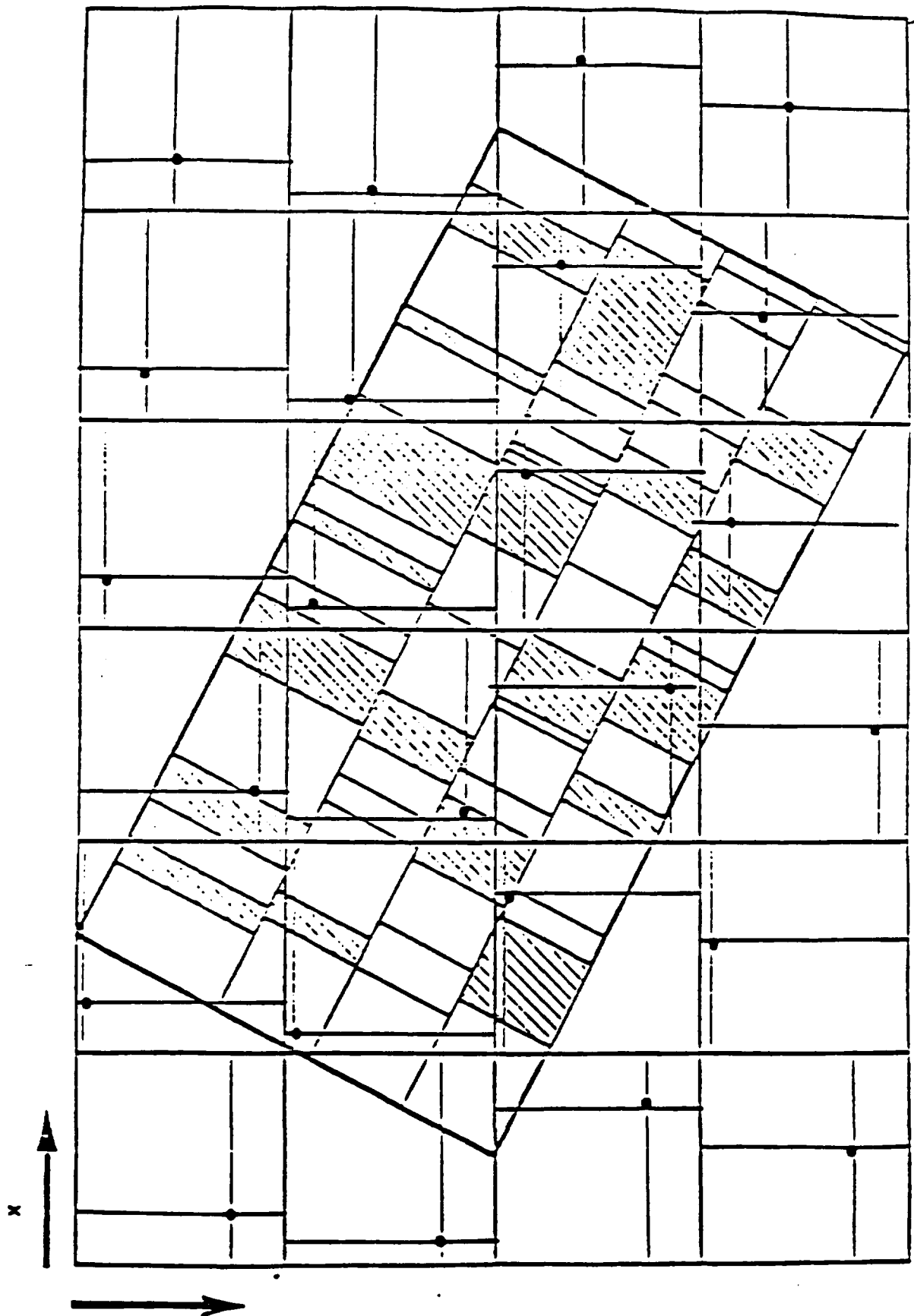


Figure 9: Unaligned Random Sampling on a Regular Grid

(4) All sampling points are now located on the grid:

For all sampling points in the columns, the y-coordinates of cells 2,3,4,5 and 6 are valid and for all sampling points in the lines the x-coordinates of cells 7,13 and 19 are valid.

In general, the spacing of each set of grid lines has to be fitted to the dimensions of the site and to the problem.

f. 'W' or 'X' Patterns

These are simple patterns in which the individual sampling points are located on linear traverses of the site, laid out in the form of an imaginary letter 'W' or 'X' drawn across the site. They do not depend on prior knowledge of the distribution of contamination and are therefore appropriate for sites having a heterogenous distribution. Because relatively few sampling points are used and the linear traverse do not cover all parts of a site, these patterns will not define the degree and extent of contamination adequately on contaminated sites. Their principal use has been in the sampling of agricultural land and geological formations as well as for such purposes as soil surveys and mapping. When utilized for these applications the samples collected from the individual sampling points are mixed prior to analysis, so that the data obtained represents average values concentration. This is a further disadvantage to their use in investigating contaminated sites (see figure 10).

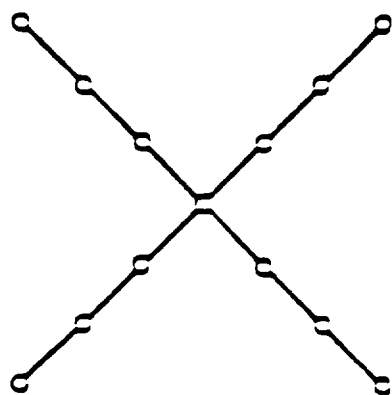
6. Depth of Sampling and Sample Quantity

Costs and the necessity to obtain homogenous material call for composite samples. It is necessary to take care that samples of potentially higher contaminated material are not mixed with less contaminated material (esp. coarse gravel, stony sands). Dilution in this manner may lead to concentrations below detection limits.

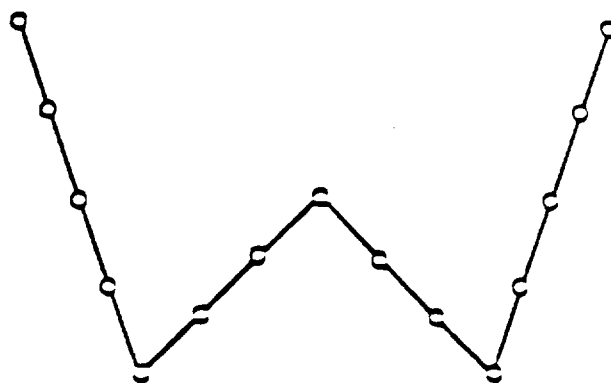
Only a portion of the samples from each auger should be used for composite samples. Part of the original sample thus remains available for special analysis later on.

The number of samples from a borehole depends on the kind of information asked for and on the degree of homogeneity of the soil, especially within the soil profile. Different soil horizons should not be mixed. Comparability of analytical results is the main aim. These results should be interpretable in relation to the area, the soil, infiltration, etc.

The depth of sampling depends on the expected kind and distribution of the contaminant and the future development plans for the site.



X



W

Figure 10: Non-Systematic Patterns

Table 15

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Estimated maximum particle size in soil sample in mm	Sample quantity in g not less than
2	500
5	500
10	700
20	2.000
30	4.000
40	7.000
50	12.000
60	18.000

} 1000 minimum

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Table 15

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Estimated maximum particle size in soil sample in mm	Sample quantity in g not less than
2	500
5	500
10	700
20	2.000
30	4.000
40	7.000
50	12.000
60	18.000

} 1000 minimum

1000 minimum
17
2018
5.7

B. Equipment and Sampling

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1. General

The aim of soil sampling is to obtain material of representative composition to be used for physical, chemical and biological investigation.

From the technical point of view the main problem arises from the fact that different soil types require specific types of boring/digging. Based upon the results of preliminary investigations it should be known which soil profile and what groundwater levels are to be expected and which sampling tools are to be used.

2. Auger-Drilling

Augering by hand (e.g. groove borers, tube borers, rotating borers, sampling spoon for marshes, twist drills), has advantages in its simple application. It may also be used to carry out profile descriptions.

Applying these techniques has the disadvantage that only small amounts of (soil) material are obtained. Selection of types of augers should be adapted to the amount of material necessary. Care should be taken that the sample is representative for location and that cross contamination by the tool itself is avoided.

Advantages are:

- low costs
- possibility to take additional samples around a once fixed sampling point in a very short time to obtain a representative sample (clustering).

Stony soils or very thin soil layers cause difficulties in obtaining the necessary amounts of material. In cases like these samples must be taken from greater areas of equal soil horizon types.

3. Other Sampling Techniques

Other sampling techniques include percussion boring, pulse boring (water hammer), hydraulic bit boring, i.e. techniques used to reach a certain depth. Sampling has to be done by special methods. These techniques are more expensive and therefore need specially trained personnel or specialized operators.

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Disadvantages are:

- sampling requires a specialist on the site
- risk of contamination due to the use of tools, machines, drilling fluids, etc.

4. Diggings (trial pits)

Trial pits provide reliable information on stratification and types and character of soil, and state likewise the presence of any water body. They also make collection of soil samples easy and provide a direct means of testing the soil in the pit walls and at the bottom. However, the excavation of deeper pits is generally more expensive than hand borings. Below groundwater level or in cases of high flow groundwater ingress, pit will be of lesser value.

5. Special Equipment for Taking Undisturbed Samples for physical geological and biological purposes

C. Sampling

1. Documentation of Sampling Points

A sample should have a reference number which is composed of the x- and y- coordinates of the sample location and the depth of the sample location and a log should be attached.

Every sample should be entered into blank form including the date of sampling, depth of sampling, color (at native moisture), soil group (variety, form and a rough description after preliminary survey) land utilization, odor. The color may be compared to standard color codes.

2. Transport and Preservation of Samples

Sampling and storage should be done in accordance with the investigating laboratory.

If the survey parameters are not known definitely at the time of sampling, the use of glass bottles with wide mouth and standard ground joint for storage and transportation is recommended. If parameters are known, the use of other suitable containers is possible. Each container must be marked with the particular sample number.

During transportation it might happen that some kinds of soil, especially those which are non-cohesive, very dry or which contain higher amounts of stony material, are separated into single particle sizes. Before using these samples for analysis it is important to homogenize them again, (e.g. application of a mechanical sample splitter, but proceed with caution if parts of

1

the apparatus are made of chromium-nickel alloys or galvanized strip).

Samples should be stored cool and dark, if necessary.

D. Preparation for Analysis

Preparation for analysis is part of the analytical procedures and therefore dealt with in standards on soil analysis.

E. References

DIN 4021	Part 1	Subsoil; exploration by diggings (trial pits) and borings as well as sampling; indications in the soil
DIN 4022	Part 3	Subsoil and ground water; Designation and description of soil types and rock; Borehole log for boring in soil (loose rock) by continuous extraction of cores
DIN 4023		Borehole logging; graphical representation of the results
DIN 4047	Part 3	Water engineering for agricultural lands, terms; pedological basis
DIN 4220	Part 1	Soil evaluation for site description; survey and signification
DIN 18 121	Part 1	Subsoil; testing procedure and testing equipment, water content, determination by drying in oven
DIN 18 123		Subsoil; testing of soil samples, determination of the particle size distribution
DIN 18 915	Part 1	Landscaping; soil working for technical vegetation purposes, evaluation and grouping of soils
DIN 19 671	Part 1	Soil drillings apparatus for drawing soil samples in agricultural engineering; groove borers, tube borers
DIN 19 671	Part 2	Soil drilling apparatus for drawing soil samples in agricultural engineering; rod, rotating borers, sampling space, sampling spoon for marshes, twist drills
DIN 19 672	Part 1	Apparatus for drawing soil samples in agricultural engineering; apparatus for soil sampling in undisturbed situations
DIN 19 672	Part 2	Apparatus for drawing soil samples in agricultural engineering; apparatus for the investigation and drawing of peat samples
DIN 19 680		Methods of research in agricultural hydraulics; ascertainment of soil profiles and observation of the groundwater

- 1 Bodenkataster Bayern, Merkblatt für die Entnahme und Aufbereitung von Bodenproben zur Untersuchung von Schwermetallen in Boden- herausgegeben vom Bayerischen Geologischen Landesamt, München 1985.
- 2 Seifert, D (1985): Bestimmung von Blei, Cadmium, Zink, Nickel, Thallium und Arsen in Boden und Siedlungsabfällen (Klarschlamm, Mullkompost): Kritische Bestandsaufnahme und Empfehlungen - Joseph-König-Institut, Landwirtschaftskammer Westfalen-Lippe, Einzelstudie zum FE-Vorhaben, 104 03 186, Dez. 1982.
- 3 Bodembescherming SSB - Voorlopige praktijkrichtlijnen - Herausg. Ministerie van V.R.O.M. Staatsuitgeverij, s'Gravenhage, 1986.
- 4 Bodembescherming 56 - Aanpak van veldonderzoek bij gevallen van lokale Bodemverontreiniging - Heraus.: Ministerie van V.R.O.M., Staatsuitgeverij, s'Gravenhage, 1986.
- 5 Bodenschutskonzeption der Bundesregierung - Der Bundesminister des Inneren, Bonn 1985.
- 6 Zusammenstellung Bodenschützender Rechtsvorschriften des Bundes -Umweltbundesamt Berlin, 1984.

SUPPLEMENT 2

SUPERFUND SOIL LEAD ABATEMENT DEMONSTRATION PROJECT PROTOCOL FOR SOIL SAMPLING AND ANALYSIS

SOIL SAMPLING

A. Site Description

1. General Site Description

For each location, a detailed drawing should be made that shows the boundary of the lot, the position of the main building and any other buildings such as storage sheds or garages, the position of the sidewalks, driveways, and other paved areas, the position of the play areas if obvious, and the position of the areas with exposed soil (grassy or bare) (See Figure 11). Show down spouts and general drainage patterns. Identify each soil subarea by letter or number. If a large soil area needs to be divided into smaller patches for sampling convenience, show how this division was made.

In addition to the diagram, briefly describe the location, including the following information:

- Type of building construction
- Condition of main building
- Condition of lot (debris, standing water, vegetation cover)
- Nature of adjacent property
- Presence and type of fence
- Animals on property
- Apparent use of yard (toys, sandbox, children present)
- Underground utilities

2. Subarea description

For each soil subarea identified on the general diagram, draw a full page diagram showing the approximate dimensions and position relative to the building foundation (see Figure 11). Indicate vegetation and bare soil areas, as well as obvious traffic patterns. Identify the category of landuse, such as roadside, property boundary, adjacent to foundation, play area. Select an appropriate sampling scheme and mark the sample locations on the diagram.

3. Sampling Schemes

The sample scheme selected for each subarea must adequately characterize the potential exposure of children to lead in the dust from this soil. It must identify the areas of high lead

concentrations, and the general distribution pattern of lead concentrations at the soil surface. For abatement purposes, the depth to which lead has penetrated the soil profile must be determined. Consequently, selecting the most appropriate sampling scheme is the critical element in the site description. Several options are offered for the best judgement of the investigator.

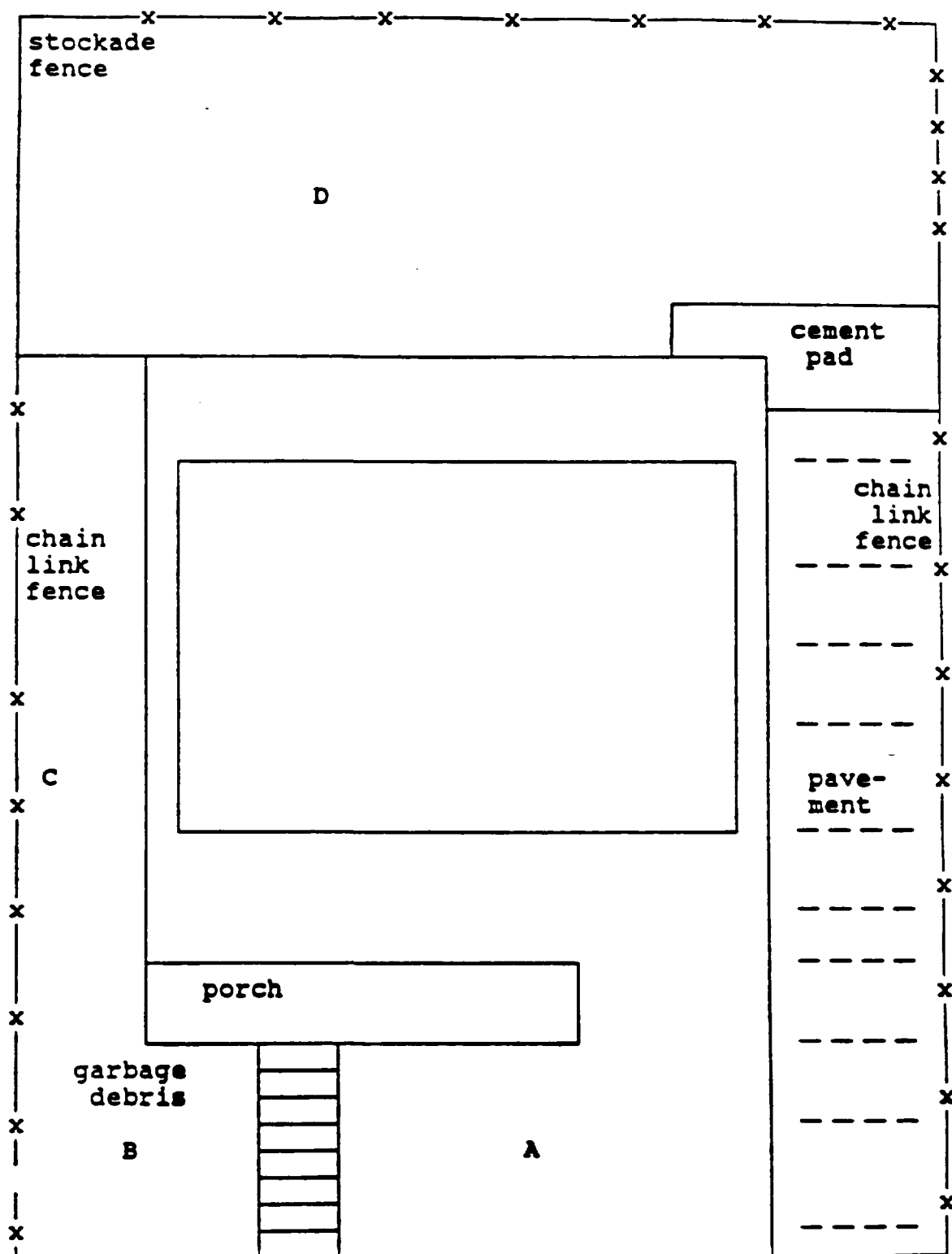


Figure 11. 37 Havlock Street
Site Sketch and Sample Diagrams

a. Line Source Pattern. This pattern can be used whenever the source of the lead is thought to be linear, such as along a building foundation, a fencerow, a street, or beside a garage. Draw a line parallel to the source, such as the foundation of the main building, approximately 0.5 meters (20 inches) from the foundation. Repeat at the property boundary if the subplot is more than three meters wide (10 ft.), and add a third parallel line between the first two if the subarea exceeds five meters (16 ft.) in width. Divide each line into segments that do not exceed 7 meters (20 ft.) in length. Take on composite of 5-10 cores along each line segment. A subarea, for example, that is at the side of the main building and measures 12 x 7 meters would have three lines of two segments each. The lines would be parallel and approximately three meters apart. They would be 12 meters long and consist of two 6 meter segments each, making a total of six samples, each being a composite of at least five cores divided into a top 2 cm sample and a bottom 2 cm sample. (Figure 12, Diagram 1-A).

b. Targeted Pattern. This method is intended to be used in conjunction with the line source or grid patterns as a means of sampling obvious areas that would be missed by the regular patterns. In using the targeted pattern, the investigator should select those locations within the subarea that are likely to reflect potential exposure to lead in soil dust. These may be play areas, paths, drainage collection areas, or areas that are likely to contribute dust to other surfaces that children use. Determine the number of samples to be taken by identifying distinctive landuse characteristics (path, swingset, sandbox), and take a composite of 5-10 cores for each sample. (Figure 12, Diagram 1-B).

c. Small Area Pattern. When the subarea is less than two meters in each dimension, or when the accessible area of a larger plot is less than four square meters, a single composited sample may be taken if it appears that such a sample would adequately represent the subarea. (Figure 12, Diagram 1-C).

d. Grid Pattern. Establish a rectangular grid of intersecting lines 2-10 meters apart, and sample each rectangular area. For larger areas, randomly select the rectangles to be sampled. In each rectangular area, mark three lines parallel to the longest axis, and composite 5-10 cores along each line. Since the rectangle should not exceed four meters, there is no need to divide the line into segments. Therefore, each rectangle should have six samples of 5-10 composites each. Use this pattern when the subarea is generally uniform and there is no reason to suspect large variations in lead concentrations. (Figure 13, Diagram 1-A).

e. Visual Location. When the sample sites have been located on the subarea diagram and the sample collection is ready

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Example of
Neighborhood
Sampling Pattern

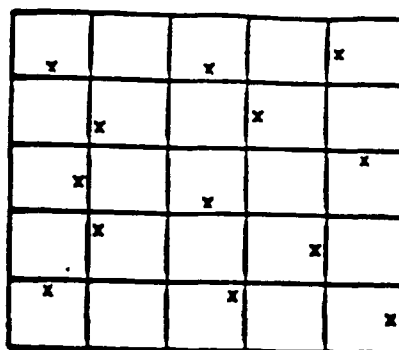
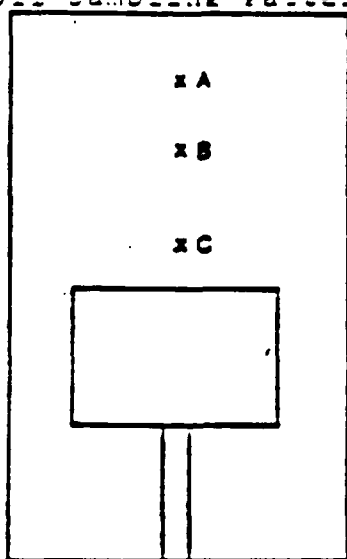


Diagram 1-A

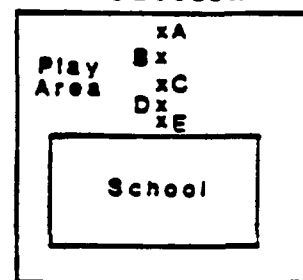
Example of Yard
Soil Sampling Pattern



Composite of 2" Plug
6" Depth A, B, & C
Yielding a Single Value
for this Home (Litter
Removed)

Diagram 1-C

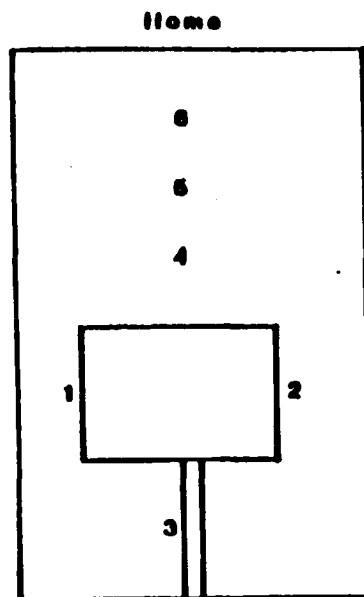
Example of School
Playground Sampling
Pattern



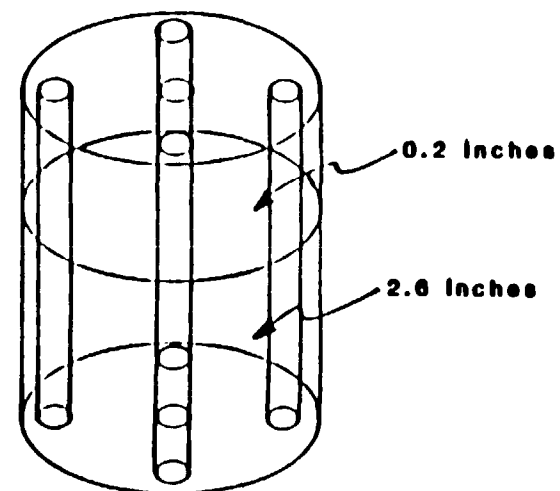
Composite of 2" Plug
6" Depth A to E
Yielding a Single Value

Diagram 1-B

Figure 12 Preliminary Soil Sampling



12-18 Composite Samples
Analysis will be Performed
on Each Home
Diagram 1-B



Remove Litter
Composite 5 Plugs 0-2" Deep
Composite 5 Plugs 2-6" Deep
Diagram 1-C

Commercial Lot

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Diagram 1-A

to proceed, locate each sample with a flag and visually confirm an even and representative distribution of sample location. (Figure 13, Diagram 1-B).

B. Sample Collection

The flags or other markers represent the center of the sample location for the targeted and small area patterns. For the line source and grid patterns, the flags indicate the sampling lines. Take at least five but not more than ten cores randomly selected from within the sampling area of the targeted and small area sampling patterns, and uniformly spaced along the sampling lines of the line source and grid patterns. The cores make a composite identified as a single sample. A sample record sheet is used to record information about the composite. The corer should be clean and free of lead contamination. Vegetation and debris can be removed at the point of insertion, but do not remove any soil or decayed litter. The corer should be driven into the ground to a depth of at least 10 cm, 15 cm if possible. If the 10 cm depth cannot be reached, the corer should be extracted and cleaned, and another attempt made nearby. If the second attempt does not permit a 10 cm core, the sample should be taken as deep as possible, and the maximum depth of penetration noted on the sample record sheet. Every effort should be made to take all cores of a composited sample at the same depth.

The cores of each plot should be examined for debris, artifacts, and any other evidence of recent soil disturbance. These should be noted on the subarea description sheet, as should a brief description of the soil color and soil type.

For each sample location, the top 2 cm segment of each of the cores are composited into one sample, and the bottom 2 cm segment combined into a second. For the surface segment, debris and leafy vegetation should not be included with the sample. However, no soil or decomposed litter should be removed, as this is the most critical part of the soil sample and is likely to be the highest in lead concentration.

The soil core segments should be composited in sealable polyethylene containers suitable for prevention of contamination and loss of the sample. The sample identification number should be placed on the container and the sample record sheet. After each sample composite, the corer should be cleaned by reinsertion in the next sampling area. Store the composited soil sample at ambient temperature until returned to the lab.

A field blank* should be taken for each sample crew day. This is normally done by taking a sample container with clean quartz sand into the field, opening it to expose the container for a period of time representing normal sample procedures, then returning the container to the lab in the same manner as other soil samples. The purpose of the field blank is to detect

accidental or incidental contamination during the sampling process. Figure 14 illustrates a national sampling strategy and classification of samples.

*Field blank was deleted at Boston coordination meeting.

C. Sample Handling And Storage

The sample containers should be sealed to prevent loss or contamination of the sample. Shipping containers should also be airtight. Storage should be in a cool, dry location.

D. Record-Keeping And Sample Custody

Soil sample records for each location consist of a location diagram and description, a plot diagram for each distinct soil plot, and sample record sheet for each sample in a plot. The sample record sheets should also contain space for chain-of-custody documentation.

Samples should be sequentially numbered within each subarea. Each location diagram, subarea description, and sample record sheet should bear all sample numbers and the signature of the person responsible for verifying the quality of the information collected. This signature certifies that there has been no misuse of the sample protocol, no mistake in recording the information, and that the information is sufficient to clearly identify these samples for comparison with other types of samples taken at the same location, such as street dust, house dust, house paint, blood, and hand dust. These documents also establish the chain of custody required for the Quality Assurance Plan.

When the sample is delivered to the laboratory, custody is relinquished by the field investigator and received by the lab supervisor by signatures on the sample record form.

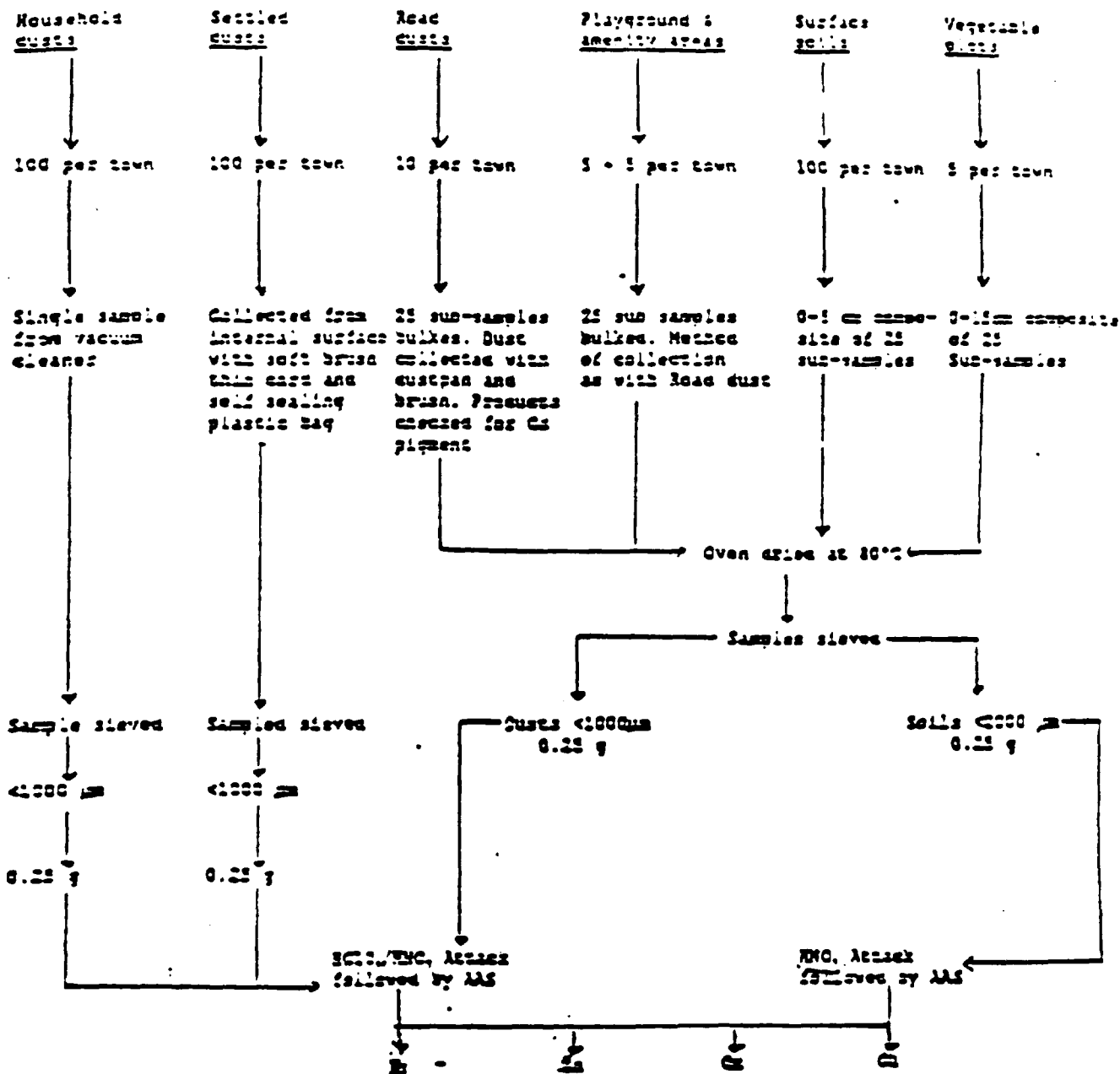
SAMPLE ANALYSIS

A. Method Of Analysis

Three methods of analysis have been considered. They are Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma Emission Spectroscopy (ICP), and X-Ray Fluorescence (XRF). The XRF method is the approved method for routine analyses, whereas the AAS method should be used for standardization.

1. Sample Definition. The representative urban soil sample is defined as the soil from 0-2 cm depth that passes a 250 cm stainless steel sieve. This fraction is comprised of small particles, and the concentration of lead believed to be closely related to that of particles on the hands of children. The

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Nationwide Reconnaissance Survey of Metals in Dusts and Soils
Sampling Strategy and Classification of Samples

Figure 14. Nationwide Reconnaissance Survey

where is
diagram from
can we get a
more
copy?

says who?

...FT

fraction is also homogeneous enough to allow reliable analysis by X-Ray fluorescence.

2. Sample Preparation. Sample preparation requires that the sample be air dried and separated by particle size before being digested by wet chemistry. Drying is done at room temperature overnight or until the sample can be easily disaggregated by hand or with a rolling pin. The full sample should be brought to complete disaggregation by passing through a 2 cm sieve, using the fingers or a stainless steel tool to crush the larger soil particles. Material larger than 2 cm should be discarded. Soil should not be milled to a fine powder with a mortar and pestle or any other grinding device.

The fraction that passes the 2 cm sieve is now called the total soil fraction. A portion of this sample is retained for possible reference analysis, but the larger fraction is passed through a #60 mesh sieve (250 μ m), giving a fine soil fraction identified as the "Urban Soil Sample". The portion that does not pass the #60 mesh sieve should be discarded, as only the total soil fraction (<2 mm) and the fine soil fraction will be analyzed.

About 5-10% of the retained total soil samples should be analyzed. An aliquot is ground so that it all passes a #60 mesh (250 μ m) sieve, mixed well and analyzed. Grinding is necessary to provide low/appropriate variance in XRF analysis.

During the processing of the sample, it should be remembered that small soil particles may individually be as high as 50,000 μ g Pb/g, and paint fragments as high as 300,000 μ g/g. Care should be taken to clean equipment between samples. The sieves may be cleaned by tapping on a hard surface to remove residual particles, or any other dry method. Wet washing is not recommended as this will interfere with the size calibration.

Care should also be taken to thoroughly homogenize the separated sample before removing the aliquot for analysis. Shaking will cause separation. Tumbling or stirring is recommended.

B. Atomic Absorption Spectroscopy (To be used for primary standards)

1. Wet Digestion. The extraction procedure used for solubilizing soil lead is critical to the interpretation of the results of the Superfund Soil Lead Abatement Demonstration Projects. Even in the absence of analytical errors, the data may not represent the same lead concentrations from sample to sample unless the correct extraction procedure is used. The method selected here does not represent the total extraction of lead, but the breakdown of the organic material and the leaching of lead from the inorganic soil fraction. The methods measure tota.

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non-matrix soil lead, because no other extractable fraction has been experimentally shown to measure bioavailable, or non-HF extractable, soil lead. Hot HNO_3 has been repeatedly shown to extract total non-matrix soil lead, or at least >95% of soil lead, compared to a total soil dissolution method (HF). The 1.0 N HNO_3 cold shake method has been shown to extract as much lead as the hot HNO_3 extract, except for unpolluted soils where a higher fraction of the total soil lead is within the matrix of soil particles.

The sample should be oven dried at 105°C for 24 hours or until a constant weight is achieved. The aliquot should be placed in a 150 ml beaker and covered with a watch glass. Class A borosilicate glassware and stainless steel tools should be used throughout the sample processing. Low density conventional polyethylene containers may be used to store the solution prior to analysis.

An aliquot of 1 g soil is normally considered representative of the whole sample if the soil is well mixed. Prior to removing the aliquot, the sample should be stirred with a spatula or rod. Shaking the container can cause the sample to separate by particle size.

2. Hot HNO_3 Extraction. Add 50 ml 7N HNO_3 , cover and digest gently at 95°C for 2 hours, stirring occasionally. If excessive foaming occurs, remove from the heat periodically until foaming subsides. Maintain at least 25 ml in the beaker by adding 7N HNO_3 as necessary.

Cool and dilute with 10 ml 1N HNO_3 . Filter through Whatman No. 42 filter paper into a volumetric flask. Rinse filter and labware with 1N HNO_3 , and dilute to volume.

3. Cold HNO_3 Extraction. Weigh the 1 g aliquot into a 4 oz. urinalysis cup. Add 50 ml 1.0 N HNO_3 to each cup. Screw the lid on tightly and place on a reciprocal shaker. Adjust the speed of the shaker to maintain a suspension of the soil particles. Shake for one hour, then filter through a Whatman 111-V filter. Rinse with 1.0 N HNO_3 . Dilute to standard volume.

4. Analysis. Analysis by flame AAS should be at 283.3 nm, with background correction. Working standards should be prepared fresh daily, in the range of 2-50 $\mu\text{g/g}$, in a 1.0 N HNO_3 matrix.

5. XRF Analysis.

Approximately 2 g of loose soil sample are poured into sample cups (Somar Labs, Inc., Cat No. 340), fitted with windows of 1/4 mil thick X-ray polypropylene film (Chemplex Industries, Inc., Cat NO. 425). The sample cup should be at least half full. The sample cup is sealed with a sheet of microporous film (Spex

Industries, Inc., Cat No. 352A) held in place by the snap-on sample cup cap. The exact weight of the sample is not important, but should be in the range of 2-6 g.

The instrument configuration for the Kevex Delta Analyst Energy Dispersive X-ray Spectrometer is:

- 1) Kevex Analyst 770 Excitation/Detection Subsystem:
 - a) X-ray tube: Kevex high output sodium anode
 - b) Power supply: Kevex 60 kV, 3.3 mA
 - c) Detector/cryostat: Kevex Quantum - UTW lithium, drifted silicon. 165 eV FWHM resolution at 5.9 KeV.
- 2) Kevex Delta Analyzer:
 - a) Computer mainframe: Digital Equipment Corp., PDP 11/73
 - b) Computer software: Kevex XRF Toolbox II, Version 4.14
 - c) Disk drives: Iomega Bernoulli box, dual drives, 10 MB
 - d) Pulse processor: Kevex 4460
 - e) Energy to digital converter: Kevex 5230
- 3) Operating conditions:
 - a) Excitation mode: Mo secondary target with 4 mil thick Mo filter
 - b) Excitation conditions: 30 kV, 1.60 mA
 - c) Acquisition time: 300 livetime seconds
 - d) Shaping time constant: 7.5 microseconds
 - e) Sample chamber atmosphere: air
 - f) Detector collimator: Ta
- 4) Analytical conditions:
 - a) Escape peaks, but not background should be removed from all spectra
 - b) The intensity ratio, defined as the integral of counts in the Pb (LA) window divided by the integral of the counts in the Mo (KA) Compton scatter window, should be determined for each spectrum
 - c) The intensity ratios for the standards should be used to determine a linear least squares calibration curve
The acquisition time (3c) may be reduced at the discretion of the lab supervisor.

6. QA/QC.

By blind insertion into the sample stream (where possible), the QA/QC officer will provide the following blanks at the indicated frequency. At the discretion of the project director, the field team will collect one blank per day by carrying a sample of clean quartz sand into the field in a normal sample container. The sample container will be opened and exposed during the collection of one sample, then closed and returned to the lab. The field blank can be split into two aliquots. One aliquot, the field blank, can be analyzed directly with no further treatment. The second aliquot (the sample blank) can be analyzed after it has passed through the sample stream (except sieving). The field blank represents contamination added in the field, the sample blank represents contamination added in the field and during storage and sample preparation.

A project standard soil sample will be prepared and distributed at the beginning of the study. This will be used as a lab control. For XRF analysis, there is no need for a reagent blank.

Field blank*	1/field sampling day
Sample blank	1/field sampling day
Lab control	1/20 samples
Reagent blank	3/reagent batch

Additionally, split sample (duplicate) analyses and spiked samples** will be determined as follows:

Split soil	1/20 samples
Spiked soil	1/20 samples

The spiked soil samples will be prepared by mixing dried and sieved soil of known concentration with the sample. Spiked soil samples may be used at the discretion of the project director. Additional split soil samples will be sent to a designated QA/QC laboratory for analysis using the hot HNO₃ method, one for each 40 samples.

An interlaboratory comparison, similar to the soil pilot study, will be conducted during each six month period, with 10-20 samples from each laboratory, including the QA/QC lab. These samples will be dried, but not sieved.

*Field blank was deleted at Boston coordination meeting.

**At Boston coordination meeting the spiked soil sample was deleted.

no field blanks
no spiked samples

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SUPPLEMENT 3

DATA HANDLING AND PATTERN RECOGNITION FOR LEAD CONTAMINATED SOILS

A. INTRODUCTION

In the experimental sciences hypotheses are tested by devising procedures in which the effects of any disturbing factors are closely controlled or minimised. But in the field sciences hypotheses are tested by sampling, analysis and data evaluation. The analytical data are essentially "noisy". Some indirect control is possible since a carefully prepared sampling protocol will ensure that samples are "representative" and collected from similar environments and confined to a single species. Known or suspected influences can be recorded, quantified and their effects compensated for later on. But even if sampling and the subsequent analyses are done correctly the researcher is still faced with the problem of making sense out of a mass of variable data.

There are many laboratory manuals which provide guidance on the choice of analytical techniques and quality assurance controls. In contrast with the ready availability of laboratory manuals, advice on data interpretation is scattered in the literature. There are, of course, some admirable texts covering elementary statistics but it is the experience of most practitioners that their usefulness is limited when dealing with "real" data. The objective of this supplement is to describe a systematic approach to the interpretation of one kind of field data, namely lead concentrations in soil samples derived from systematic or random surveys. A knowledge of standard statistical tests is assumed and further information on these may be derived from Cole and King (1968), Davis (1973), Krumbein and Graybill (1965), Mead and Curnow (1983), Parker (1973) and Till (1974).

B. THE NATURE OF SOIL LEAD DATA

not in ref's

The simplest descriptive statistic is the mean, the sum of the measurements divided by the number of measurements. Besides calculating the mean, computer packages usually provide the standard deviation, the spread of the values around the mean. It is also helpful to establish the minimum and maximum values. But data assessment should not stop at this point since these parameters do not fully evaluate the data. It is important that the median value be calculated. This is the middle value when metal concentrations are arranged in order of increasing concentration.

Table 16 illustrates soil lead concentrations from a typical survey (Davies and Ginnever, unpublished data). The arithmetic data are characterised by a feature which is common in this kind of data, namely that the mean is greater or very much greater

Table 16

A summarisation of soil lead concentrations derived
from 174 soil samples collected in north Somerset

<u>mg Pb/kg soil</u>		
Parameter	B	Arithmetic, Transformed
Mean,	183B	66
Median	52X	52
Minimum	8n	8
Maximum	10223	10223
St. Devn.B	798B	3 h"X2

than the median. The most common inference drawn from the value of the mean is typicality, the average value. But the median is also a measure of central tendency. It is the value of the middle sample when all sample values have been arranged in rank order from lowest to highest. The two statistics are seen to differ in Table 16, the mean being 3.5 times greater than the median. The distribution is positively skewed and in this instance the median far better represents central tendency than does the mean.

Many statistical packages will also provide the skewness or third moment statistic. A positive value indicates a clustering of samples to the left of the mean.

The most commonly used statistical techniques (analysis of variance, regression analysis or correlation analysis) are so-called 'parametric' tests. They require the test populations to be normally distributed, i.e., they should not be skewed. Populations can be normalised by transforming the data and a common transformation is to convert each value to its logarithm (the common \log_{10} or the natural \log_e). Table 16 shows the result of a \log_{10} -transformation. Recalculation and anti-logging yields the geometric mean (66 mg/kg) which is only 1.3 times the median (52 mg Pb/kg). The reduction in spread is reflected in the geometric deviation (3.0) compared with the standard deviation (798). As a general rule, all soil lead data should be log-transformed before statistical analysis.

The way in which the range is quoted needs careful consideration. Of course the observed range should be published as in Table 16. But only the very occasional sample in the study area approaches the observed maximum (1.0% Pb, rounded). A different measure of range must be used if typicality is to be inferred. Any introductory text on statistics will explain the normal distribution curve. A property of this curve is that the proportion of the area underneath it is described by the mean \pm some multiple of the standard deviation. The mean \pm 2s accounts for 95.5% of the area and the mean \pm 1.96s accounts for 95% of the area. Similarly, mean \pm 3s accounts for 99.7% of the area and mean \pm 2.58s accounts for 99% of the area. From this it is useful to quote the 95% probability range (mean \pm 1.96s) using the log-transformed data. This was done for the data summarised in Table 16 and indicated that for the Mendip Hills of north Somerset most soil lead concentrations lie between 8 and 577 mg Pb/kg.

The approach outlined above is not, of course, the only way of summarising voluminous data. But the suggested statistics are easily calculated using a microcomputer. Appropriate programs can be written in BASIC or are available as commercial packages.

What did they do here?
 $\text{mean } \log \pm 1.96 S(\log s)$
 exp L

$$\begin{aligned}\log_{10} 66 &= \bar{X}(\log_{10}) \\ &= 1.8195 \\ \log_{10} 3 &= S(\log_{10}) \\ &= .47712\end{aligned}$$

$$\begin{aligned}1.8195 + (1.96)(.47712) &\approx 2.75 \\ \text{exp}(2.75) &\approx 563 \approx 577\end{aligned}$$

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C. IDENTIFICATION OF CONTAMINATED SOILS

There is no simple, unequivocal way of recognising when a soil has been contaminated or polluted by lead since it occurs naturally in all soils, albeit at very low concentrations. The problem of recognising whether contamination has taken place becomes one of deciding whether the measured concentration is within the range of what could occur naturally for that soil or whether the measured concentration is anomalous.

Quantitative approaches to the description and evaluation of lead and other trace element data for soils are still in their infancy and it is not clear what is the best model to describe the variability of soil metal concentrations. Ahrens (1954, 1966) has proposed that the distribution of elements in igneous rocks approximates to a log-normal distribution. This model does not necessarily apply to soils but the available evidence suggests it may. Its applicability underlies the interpretation of geochemical data in mineral exploration.

Rose et al. (1979) discuss the concept of threshold, the upper limit of normal background fluctuations. Values above background are considered anomalous. This approach is directly applicable to contamination studies since a contaminated soil is an anomalous soil. The simplest way of identifying threshold concentrations is by collecting samples from apparently uncontaminated areas (e.g., those remote from urban or industrial influences). After analysis the geometric means and deviations are calculated. The threshold is then the value lying two or more standard deviations from the mean, depending on the probability level required. An anomalous value is one which lies above the threshold. Where more than one sample is apparently anomalous then the differences between the two groups (control and anomalous) can be assessed by standard statistical tests such as the familiar t-test.

Very often it is not possible a priori to separate contaminated and uncontaminated soils at the time of sampling. The best that can be done in this situation is to assume the data comprise several overlapping log-normal populations. A plot of cumulative frequency versus concentration (either arithmetic or log-transformed values) on probability paper produces a straight line for a normal or log-normal population. Overlapping populations plot as intersecting lines. These are called broken line plots and Tennant and White (1959) and Sinclair (1974) have explained how these composite curves may be partitioned so as to separate out the background population and then estimate its mean and standard deviation. Davies (1983) has applied the technique to soils in England and Wales and thereby estimated the upper limits for lead content in uncontaminated soils. In the author's experience a degree of subjectivity is involved in the interpretation and often plots are not readily partitioned.

It should not be assumed that anomalous concentrations necessarily indicate contamination. Bolviken and Lag (1977) have described areas in Norway where the absence of vegetation is due to the toxic effects of high concentrations of metals in soils as a result of weathering of sulphide ores close to the surface. This is a natural process having nothing to do with contamination.

Identification of a geochemical anomaly should, in the first instance, be considered as only that, an anomaly. Other evidence must be taken into account to decide whether the anomaly is natural or is a neoanomaly, one caused by anthropogenic contamination.

D. THE PROCESSES AND PATTERNS OF LEAD CONTAMINATION

Lead contamination is a consequence of human use of the metal and its compounds. When these are heated, dissolved or pulverised they become labile and liable to escape to the environment. Having escaped they follow normal environmental pathways until they reach a geochemical sink such as soil or sediment. Valuable inferences may be drawn from the spatial distribution of lead concentrations.

Contaminating sources are generally classed as point or line. A smelter stack is a typical point source and highways are typical line sources due to the movement of motor vehicles and their exhaust emissions along them. A cluster of point sources forms an area source. But whatever the geometry of the source as contaminants are carried away they become diluted. Fallout from a stack tends to decline exponentially away from the source. Overbank inundation in river systems leads to greatest contamination nearest to the river channel. Distinctive depositional patterns are thereby created and much can be inferred about the presence and nature of contamination by studying these patterns. Cartographical interpretation of data is an essential component of many contamination projects.

E. CARTOGRAPHICAL REPRESENTATION OF DATA

Many ways are possible for representing the spatial distribution of lead data ranging from sized or coloured symbols based on the relative concentration at the sample locality to complex statistical surfaces such as trend surface plots. But whatever style of representation is chosen an essential step in the data reduction is the manner in which the concentration values are classified to produce a relatively few groupings of the data from the minimum to the maximum. This can be done quite empirically by allocating class limits from experience. But this approach involves too high a degree of subjectivity.

The simplest systematic approach is to divide the range by, say, 10. Each metal value may then be allocated to its relevant

Davies?

class and mapped. This was the method chosen by Davies (1973) for his subroutine PLOT which prints contour maps using symbols and a line printer. But skewed data again present problems. For the data in Table 16. the range is approximately 10,000 giving a class interval of 1000. But only 4 samples contain >1000 mg Pb/kg soil. here again, a log transformation improves matters. For the same data the class interval is (log) 0.3: the lowest class contains 1 value as does the highest and the data are regularly distributed through the classes.

A more laborious but more informative approach is through the frequency distribution of the data. The log-transformed values are classified (a class width of 0.1 is often suitable) and the percentage frequency in each class is calculated. These are then summed to 100%. A plot of concentration versus cumulative percent frequency is constructed and a smooth, sigmoid curve is interpolated between the points. This curve is then used to estimate the concentrations corresponding to selected percentiles. For contamination studies it is often convenient to use the 50, 60, 70, 80, 90 and 95th. percentiles. Ideally, the 50th percentile, the median and the geometric mean should be the same but irregularities in the frequencies combined with a best-fit of the curve often produce small discrepancies. Here, the 50th percentile corresponds to 40 mg Pb/kg soil compared with the geometric mean of 66 mg/kg and a median of 52 mg/kg. The 95th. percentile equates to 450 mg Pb/kg whereas the 95% upper probability limit was quoted above as 577 mg/kg (the 97th. percentile).

Broadly, there are two kinds of map. Where it cannot be assumed that there is any progressive change across a given area for the value of the parameter under investigation chloropleth maps are constructed. Areas of equal value are separated by boundaries from adjacent areas of different values. Familiar examples are soil or geology maps. But where progressive change can be assumed then isoline maps are used. Examples are topographical maps where contours connect points of equal elevation or weather maps where isobars connect points of equal atmospheric pressure. The familiarity of topographical maps compared with other isoline maps has often led to all isoline maps being loosely described as 'contour'.

It is dubious whether all geochemical data are properly representable by isoline maps. Since chemical composition depends on rock type and rock type can be depicted properly only by chloropleth maps then isoline maps are not generally suitable for geochemical data. But although soil composition is strongly influenced by parent material composition other processes are also significant, such as wind or water transportation of particles and compounds. Transportation over distance entails progressive change in deposition and therefore progressive change in soil composition. It has already been observed that the contamination effect is subject to a diminution away from the

DRAFT

Table 17

Map isopleth values for lead derived from percentiles of a cumulative percent frequency distribution of the log transformed data.

Percentile	mg Pb/kg soil
50 th	40
60 th	50
70 th	70
80 th	100
90 th	200
95 th	450

line or point source. It is reasonable to conclude that isoline maps are suitable for the study of lead contamination.

A number of computer program packages are now available for constructing isoline maps. Davies and Roberts (1978) and Davies and Wixson (1985) used the SYMAP system where isoline maps are printed on a line printer: in the papers cited these plots were redrawn for publication. There are major mainframe computer packages which produce very high quality monochrome or colour plots with inkjet or thermal printers. When using a PC microcomputer and a dot matrix printer the SURFER system of Golden Software, Inc., Golden, Colorado, is suitable.

Whichever system is used there is an important first stage. The data are imported into the program as X, Y and Z values (two geographic coordinates and the lead concentration) and from these a uniform grid of values is created. This entails extrapolation between neighbouring values to calculate the concentration at the grid intersection. The most common involves searching over a defined radius around each sample point and averaging using a weighting factor dependent on the inverse square of the distance between points. Another method depends on a moving average system called kriging (Davis, 1973). Since production of a regular grid is an essential preliminary then the more the distribution of the original data departs from regularity the more possibility there is of distortion of the eventual geographic pattern and the higher the likelihood of misinterpreting the pattern. Where the terrain permits it is much better to sample on a grid basis rather than rely on the chosen computer algorithm to regularise the grid.

Finally, the packages which are used to generate isoline plots will generally also print perspective block diagrams. These three dimensional figures are most helpful in interpreting geographic patterns.

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December 27, 1990

FEDERAL EXPRESS

Mr. Brad Bradley
United States Environmental Protection Agency
230 South Dearborn Street
(5HS-11)
Chicago, Illinois 60604

Re: NL Industries/Taracorp, Granite City Site -
Comments to Administrative Order by Exide
Corporation

Dear Mr. Bradley:

As provided in paragraph 79 of the Administrative Order for Remedial Design and Remedial Action ("the Order") issued by the United States Environmental Protection Agency ("EPA") on November 27, 1990, Exide Corporation/General Battery Corporation ("Exide") hereby submits the following comments to the Order by and through its counsel. Exide submits these comments for ESB, Inc. and General Battery Corporation, as named on the Order. We thank EPA for extending through December 28, 1990, the period for which comments such as these may be submitted.

I. INTRODUCTION AND INCORPORATION BY REFERENCE.

Exide expressly adopts and incorporates the sum and substance of the comments of Johnson Controls, Inc., (Attachment A), including all exhibits and documents attached to or incorporated therein, as submitted by letter dated December 20, 1990 from Dennis Reis of Sidley and Austin addressed to Mr. Brad Bradley. Exide incorporates the explicit language of following paragraphs in the Johnson Controls comments:

I. INTRODUCTION

**II. A CRITIQUE OF THE RESIDENTIAL SOIL REMEDY AT
THE GRANITE CITY SITE**

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III. U.S. EPA FAILED TO CONSIDER APPROPRIATE
ALTERNATIVE REMEDIES

V. [EXIDE] IS NOT A LIABLE PARTY UNDER CERCLA

IV. CONCLUSION

In places where these sections, incorporated verbatim, refer to Johnson Controls, please read Exide Corporation. Exide does not incorporate Section IV (U.S. EPA HAS IGNORED JONSON CONTROLS' DUE PROCESS RIGHTS) of the Johnson Controls comments verbatim due to the differing circumstances from that of Johnson Controls, as described below. Exide therefore states its own similar objections below. Nonetheless, Exide concurs in the comments of Johnson Controls set forth in their Section IV.

II. EPA HAS IGNORED EXIDE'S DUE PROCESS RIGHTS.

As noted in the comments by Johnson Controls in their paragraph IV, EPA has not provided notice or opportunity to comment to Exide during the decision making process at the Granite City Site. Exide received first notice of potential liability for the Granite City Site from an EPA general notice letter dated November 28, 1989^{1/} and delivered to Exide on December 5, 1989. The notice letter indicates that the Remedial Investigation/Feasibility Study (RI/FS) was being performed by NL Industries (NL) pursuant to a consent order and that the FS was expected to be completed in January 1990.

EPA did not provide Exide with any notice that the FS was completed or that the comment period on the FS was open. Apparently, EPA published notice of the comment period in the local Granite City newspapers. EPA cannot seriously contend that this notice was reasonably calculated to provide notice to the hundreds of potentially responsible parties that EPA had previously identified. Considering that EPA identified Exide as a potentially responsible party at the site, EPA should have provided Exide with express notice of the availability and opening of the comment period for the FS when the document was completed. Not only did EPA fail to give actual notice to Exide, EPA apparently did not even publish notice in the Federal Register, the tool created to assure proper notice to interested

1/ The date stamped on this letter is not entirely legible and may be November 23, 1989.

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parties. As a result of EPA's failure to provide adequate notice, Exide, in fact, never received notice and did not have the opportunity to comment.

Accordingly, Exide was completely denied its right to comment on the feasibility study for the Granite City Site and the remedy proposed as a result of that Feasibility Study.

III. ALTERNATIVE REMEDIES - POSSIBLE SETTLEMENT

As noted in section III of the comments submitted by Johnson Controls, which is incorporated herein by reference, EPA failed to give appropriate consideration to alternative remedies for the Granite City Site, in particular, but not limited to, the area where soil-lead concentrations are between 500 ppm and 1000 ppm.^{2/} At the meeting held in EPA's offices in Chicago on December 21, 1990, the PRPs presented information to EPA concerning the potential for treatment of these soils by conditioning the soils through tilling. EPA was provided with a Summary Table (attached hereto as Attachment B) of soil-lead concentrations before and after soil conditioning at an Exide facility in Selma, Alabama. As can be seen from the table in Attachment B, lead concentrations after tilling are dramatically reduced.

At the December 21 meeting, EPA requested more information concerning this project. Exide is please to submit the following documents in response:

Attachment C

December 1986 Field Investigation Report for General Battery Corporation's (GBC's) Selma, Alabama Plant (prepared by CH2M-Hill, Montgomery, Alabama). [Note - two reproductions of aerial photographs, which identify the location of the sampling points, have not been

^{2/} Exide notes that the Feasibility Study does not appropriately address this area. Without appropriate consideration in the Feasibility Study, EPA has failed to comply with the National Contingency Plan, as required. Other instances of non-compliance also appear to exist. Exide reserves the right to raise these issues as they become apparent.

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reproduced with this Report. Reproductions of these same materials are included with Attachment G, below].

Attachment D

February 13, 1987 letter of transmittal of Field Investigation Report to the Alabama Department of Environmental Management (ADEM).

Attachment E

April 23, 1987 letter from ADEM (confirming results of an April 1, 1987 meeting with General Battery Corporation) which, among other things, confirms GBC's intention to provide a plan for tilling of soil in certain areas at the facility.

Attachment F

GBC letter of April 4, 1988 to ADEM to submit the Closure Plan for Remediation of Lead Containing Soil.

Attachment G

May 26, 1988 letter from ADEM which notes the GBC plan to be an "acceptable procedure for managing lead-contaminated soils at the site."

Attachment H

Exide Corporation letter of April 18, 1990 which accompanied the final report of the soil clean-up project to ADEM.

Attachment I

Report of 1989 Soil Clean-up/Remedial Activities, Exide/General Battery Corporation, Selma, Alabama (April 1990). [Note - Appendix 2 to this Report, consisting of copies of Hazardous Waste Manifests and Acknowledgements of Receipt for soils shipped off-site, has not been reproduced.]

We hope that this information is sufficient for the EPA to understand the actions that were taken at the Selma site and to demonstrate that the approach should be considered at the Granite City Site.

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Exide has attempted to negotiate a settlement of the differences with EPA at this site as evidenced by the Good Faith Offer submitted by and through the PRP Committee (the PRPs) on August 31, 1990. The PRPs supplemented this offer on or about October 20, 1990. EPA did not accept either of these offers as worthy of further discussion. While EPA has attempted to provide reasons for the outright rejection of these offers, it remains unclear why these offers, particularly the supplemental offer were rejected out-of-hand. Nonetheless, Exide has continued to pursue possible settlements with EPA as evidenced by its representation through its attorney at the meeting held at your offices on December 7, 1990.

Exide continues to desire to resolve any differences with EPA concerning this site. Exide believes that a settlement can be reached if EPA agrees to allow for further study and consideration of tilling, including appropriate cover and other soil amendment, as an appropriate remedial action for the site.

Considering the apparent deficiencies in EPA's choice of the 500 ppm cleanup standard and in the choice of the remedy for areas with total lead concentration between 500 and 1000 ppm, Exide does not believe that settlement is possible at this time without allowing for further meaningful consideration of tilling as an alternative remedy.

IV. CONCLUSION

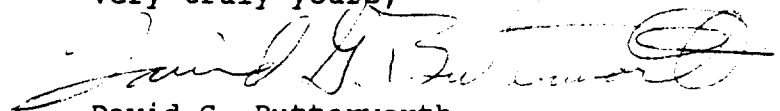
As discussed in detail in the comments by Johnson Controls, which are incorporated herein, EPA's decision to remediate soils above the level of 500 parts per million of lead is arbitrary and capricious, is unsupported by the record and is not in compliance with the law. Furthermore, Exide was not provided with notice or an opportunity to comment on the selection of the remedy. Without pre-enforcement review, CERCLA section 106 pushes the limits of due process as guaranteed by the Constitution of the United States. Accordingly, it is imperative that EPA properly justify, explain and support its remedial decisions to ensure that an appropriate remedy is selected. Furthermore, it is imperative that EPA provide notice to affected parties so that they can play a meaningful role in the CERCLA process through the submission of comments during the decision making process. EPA has, in this case, failed in its duty in both respects. First, EPA has failed to properly justify and support its decisions. Second, EPA has failed to provide

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sufficient notice to allow for an opportunity for affected parties to comment on the decisions as they were being made.

Exide, nonetheless, desires to resolve any issues concerning the Granite City Site and urges EPA to consider the information submitted with these comments. If further information is required, or if you have any questions or comments, please contact me at your convenience.

Very truly yours,

A handwritten signature in dark ink, appearing to read "David G. Butterworth", with a large, stylized flourish at the end.

David G. Butterworth

DGB/cmb

cc: Jeffrey A. Leed, Exide Corporation
Steve Siegel, EPA
Alan Held, Department of Justice

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December 20, 1990

Mr. Brad Bradley
United States Environmental
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230 South Dearborn Street
(5HS-11)
Chicago, Illinois 60604

Re: NL Industries/Taracorp Granite City Site--
Comments to Administrative Order by
Johnson Controls, Inc.

Dear Mr. Bradley:

As requested in paragraph 79 of the Administrative Order for Remedial Design and Remedial Action ("the Order") issued by the United States Environmental Protection Agency ("U.S. EPA") on November 27, 1990, we are submitting comments to the Order on behalf of our client, Johnson Controls, Inc. ("Johnson Controls").¹

I. INTRODUCTION

When amending the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") in 1986, Congress empowered U.S. EPA to select a remedy according to criteria set forth in the statute. To assure that cleanups were commenced expeditiously, Congress limited judicial review of the agency's remedy selection process to U.S. EPA's administrative record and to post-enforcement proceedings. It further dictated that the agency's decision would be considered erroneous only if arbitrary and capricious or otherwise not in compliance with law. Thus, if

¹ Johnson Controls also expressly incorporates into these comments the following documents previously submitted to U.S. EPA: (i) its March 12, 1990 comments to the proposed remedy; (ii) the August 31, 1990 good faith offer and exhibits submitted by the NL Industries/Taracorp Site PRP Committee ("the PRPs"); and (iii) the November 29, 1990 response by the PRPs to USEPA's September 14, 1990 rejection of the PRPs' good faith offer (see Exhibit A).

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U.S. EPA's decision-making process is carried out in a lawful manner, it is protected from close scrutiny. As a result, potentially responsible parties have great incentive to participate in whatever reasonable remedy the agency selected.

Conversely, the enormous power given to the agency, coupled with the substantial costs often incurred at Superfund sites, requires that U.S. EPA in good faith conform to accepted administrative procedures. At a minimum, the agency cannot predetermine an outcome. It must evaluate all the relevant evidence and reach a decision reasonably based on that evidence. Further, U.S. EPA must provide a decision document from which a party (and later a court, if necessary) can determine how the agency evaluated the evidence, why it reached the decision at issue, and whether it did so in a cost-effective manner.

The purpose of the comments is to demonstrate how and why the agency's decision is arbitrary and capricious and not cost-effective. In doing so, we will not rely on vague references to evidence, as did U.S. EPA; rather, we will extensively examine the administrative record.

The principal issue of contention at the Granite City site is the necessary cleanup level in residential soils.² U.S. EPA has chosen 500 ppm as a target level. We have looked at all the available evidence, whether or not contained in the administrative record, and completely fail to understand how, based on the evidence, the agency reached its decision. The perplexity exists on two levels. First, the great weight of the evidence we have examined, both in the administrative record and ignored by the agency, indicates that 1,000 ppm is protective of human health and the environment. Second, U.S. EPA's decision document fails to explain why it chose certain questionable statements contained in a very few documents in the record as credible support for a 500 ppm level and rejected the great weight of documents from which one should draw a different conclusion. While we understand that U.S. EPA has discretion to choose a remedy with a range of reasonableness, it cannot do so without providing a reasonable basis for the decision. Given the contradictory explanations provided to Johnson Controls in the Record of Decision ("ROD") (including attachments) and the September 14, 1990 rejection of the PRPs' good faith offer, the decision proves itself to be premeditated without regard to the evidence, arbitrary and capricious, and not otherwise in compliance with CERCLA.

² While there are other concerns, the potential impact of the cleanup level (no less than \$15 million) dwarfs them.

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As far as we can determine, U.S. EPA's argument can be expressed in a single sentence: lead is dangerous to a certain subset of children and to fetuses; thus, soil must be cleaned up to 500 ppm lead. The connection between the premise and conclusion is sorely lacking. There is nothing magical about the process U.S. EPA should follow in selecting a soil cleanup level. U.S. EPA must first determine the blood lead level at which adverse health effects occur. In the absence of an accepted level, at the very least U.S. EPA must determine a range and pick a target within the range. Second, U.S. EPA must determine the relationship between soil lead levels present at the site and blood lead levels in the surrounding population. Once U.S. EPA has determined this relationship, it can determine how a decrease in soil lead will impact blood lead levels and then choose a cleanup level which appropriately balances the likely effect with expected cost. Until it takes these simple steps, U.S. EPA has failed to properly choose a remedy at the Granite City site.

II. A CRITIQUE OF THE RESIDENTIAL SOIL REMEDY AT THE GRANITE CITY SITE

Along with several other parties, Johnson Controls commissioned an independent study of the administrative record to determine whether evidence existed to substantiate a 500 ppm cleanup level. We have included with these comments and expressly incorporate the accompanying report by TRC Environmental Consultants, Inc. ("TRC") (See Exhibit B). Before summarizing the report, however, we turn to the issue of the adverse health effects of lead.

A. Target Blood Lead Level

U.S. EPA apparently has not determined for purposes of the Granite City site the blood lead level at which adverse health effects will occur in the target population. Until recently, the scientific community has accepted the blood lead level associated with adverse health effects as 25µg/dl. However, some studies suggest a lower threshold, and U.S. EPA has expressed concern that lower blood lead levels may cause adverse health effects in children. U.S. EPA currently chooses to believe that the appropriate blood lead level of concern lies somewhere between 10µg/dl and 15µg/dl. However, U.S. EPA has not set forth any support in the ROD or the administrative record for lowering the target blood lead level to this range and has not yet determined where within this range the target should lie.

The unfairness of this procedure is evident in the administrative record. U.S. EPA noted in Appendix B of the ROD

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that a remedy which assured only 8% of the target population would exhibit levels above 15µg/dl would be acceptable. However, after the PRPs demonstrated in the August 31 good faith offer that the 1,000 ppm level adequately protected at the target blood lead level, U.S. EPA stated in its September 14 letter that 10µg/dl was a more appropriate target blood lead level. Even at that level, the 1,000 ppm standard is protective. To satisfy any semblance of due process, U.S. EPA should reasonably decide on an appropriate target blood lead level rather than changing positions every time it otherwise errs. U.S. EPA cannot rationally proceed to the determination of the relationship between soil lead levels and blood lead levels if it has not chosen the blood lead level at which adverse health effects occur.

B. Relationship Between Granite City Soil Lead Levels and Blood Lead Levels

After an appropriate target blood lead level is determined, U.S. EPA must then determine the relationship between soil lead levels and blood lead levels in the surrounding population before it selects an appropriate cleanup level for a lead-contaminated site. U.S. EPA failed to determine this relationship for the Granite City site.

TRC reviewed the Granite City ROD and associated administrative record for evidence relating to U.S. EPA's decision to select a remediation concentration of 500 ppm lead in soil. TRC's review focused upon the key arguments and citations used by U.S. EPA to justify the 500 ppm concentration. Additionally, TRC's review considered all other documents contained in the administrative record which considered the role of lead in soil and its influence on children's blood lead concentrations.³

³ We note that U.S. EPA has failed to provide the PRPs timely access to all of the documents in the administrative record. The administrative record contains one document (Document 144, "Technical Support Document for Lead," October, 1989) which U.S. EPA, claiming confidentiality, initially had refused to provide to the PRPs even though U.S. EPA admitted that this document was considered in choosing the remedy. By the time U.S. EPA finally determined that it was incorrect in withholding the document and made the document available to the PRPs on December 20, 1990, there was insufficient time left in the comment period for the PRPs and their technical experts to adequately review the document. Due to U.S. EPA's unreasonableness in withholding this (continued...)

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The major conclusions of this investigation are as follow:

1. The administrative record does not contain any scientific evidence from which one could conclude that lead in soil in the 500 ppm to 1,000 ppm range is hazardous to young children.
2. Documents used directly by U.S. EPA to support the 500 ppm decision [OSWER interim guidance;³ a study by Mielke, et al. (1988) ("the Mielke study"); a study by Shellshear (1975) ("the Shellshear study"); and a study by Milar and Mushak (1982) ("the Milar and Mushak study")]⁵ were used inappropriately and are either not scientifically supported or represent only a small portion of the scientific evidence.
 - a. The OSWER interim guidance asserts that a remediation standard of 500 ppm to 1,000 ppm is suggested because, in this range, blood lead begins to show increases. However, this guidance is not supported by any quantitative experimental evidence, and it disregards the weak effect that soil lead has been shown to have on blood lead.⁶
 - b. The Mielke study contends that children are at risk at soil lead concentrations greater than 150 ppm, and it claims that the literature supports a major effect on blood lead in the range of 100 ppm to 600 ppm soil lead. However, the Minnesota study discussed in the Mielke study did

³ (...continued)

document, Johnson Controls reserves the right to submit comments on this document at a future date.

⁴ OSWER Dir. #9355.4-02.

⁵ See the TRC report (Exhibit B) for the full citations of these studies.

⁶ It should be noted that this document is a guidance document; it was not promulgated using formal rule-making procedures. Thus, the public did not receive an opportunity to comment on the document. Since the guidance document was drafted without public input, it is all the more important for U.S. EPA to clearly justify its decision in the ROD and the administrative record.

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not match children with soil except on a regional basis. In contrast, another study on a similar Minnesota population did match children and soil, and only a weak correlation could be established between soil lead and blood lead. The Mielke study also cites five other studies which TRC has found were not valid tests of the soil lead/blood lead relationship, and either did not support the Mielke study's central argument or were poor substitutes for better conducted studies.

- c. The Shellshear study and the Milar and Mushak study do not support the 500 ppm remediation standard because neither study is directly relevant to the issue. The Shellshear study focuses upon the unique subpopulation of children exhibiting pica whose exposure should be controlled by other means. The Milar and Mushak study considered house dust lead only, without measuring or even mentioning soil lead.
 - d. The supporting documents listed above tend to confuse the importance of soil lead and house dust lead, either by citing data relating dust lead (instead of soil lead) to blood lead or by ignoring the overriding importance of dust lead when correlating soil lead to blood lead. It is important to note that the contribution of soil to house dust lead appears to be small.
- 3. Evidence in the administrative record, but apparently not used by U.S. EPA in coming to its conclusion, indicates that lead in soil is, at most, a weak contributor to children's blood lead. A host of appropriately controlled studies indicate that an elevation of 1,000 ppm in soil lead might be expected to elevate blood lead by only 1.5-2.0 $\mu\text{g}/\text{dl}$. Therefore, the difference between a 500 ppm and a 1,000 ppm remediation standard with respect to resultant blood lead levels would be minor and possibly not measurable.
 - 4. U.S. EPA's use of the Lead Uptake Biokinetic ("U/B") model in Appendix B to the ROD is flawed.⁷ In the

⁷ Apparently realizing the it had no support in the administrative record for the 500 ppm standard, U.S. EPA added
(continued...)

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August 31 good faith offer, the PRPs demonstrated very significant errors in U.S. EPA's use of the U/B model, including the following: (i) U.S. EPA used obsolete rather than current U.S. EPA data on dietary lead sources, thus overstating blood leads related to soil lead; (ii) U.S. EPA failed to account for decreasing rates of human lead absorption with increasing levels of lead exposure, again overestimating blood leads; (iii) U.S. EPA failed to use site-specific concentrations of lead in household dust; and (iv) U.S. EPA failed to consider available calibration data from four other lead sites. U.S. EPA specifically stated in the ROD and Responsiveness Summary to the ROD that it relied on Appendix B, noting that "[d]ocumentation for the selection of this cleanup level is included in Appendix B." However, after U.S. EPA received the PRPs' August 31 good faith offer, it apparently realized that it had misused the U/B model in Appendix B and stated in response that it "did not rely on use of the biokinetic model in its selection of cleanup standards at the NL Site." Even now, U.S. EPA has not made up its mind as to the basis of the 500 ppm cleanup level. Thus, if U.S. EPA did not rely on the U/B model in Appendix B, then there is no basis in the record for the 500 ppm cleanup standard. To the extent U.S. EPA did rely on Appendix B, as noted in the PRPs' August 31 good faith offer, it did so incorrectly.

5. U.S. EPA did not use an appropriate site-specific approach to establish the remediation level for Granite City. The OSWER interim guidance states that site-specific factors need to be considered when deciding whether the lead in soil standard should be set near the lower or upper end of the 500 ppm to 1,000 ppm range.
 - a. Several of the factors cited by U.S. EPA (i.e., residential nature of Granite City, unrestricted access by children to the residential area, and soil ingestion by children) are not unique to Granite City and were taken into account by OSWER when setting the range for residential areas at 500 ppm to 1,000 ppm. These factors merely demonstrate that the guidance range of 500 ppm to

⁷ (...continued)

Appendix B to the ROD after the public comment period. Thus, Appendix B was not part of the proposed plan subject to comment.

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1000 ppm of soil lead is the appropriate range to consider here; they provide no basis for selection of any point within the range because they are common to every site to which the range applies.

- b. The other factors cited by U.S. EPA (high bioavailability of lead in smelter dust and synergistic action of other industrial pollutants) are also not unique to Granite City and are vague assertions which only serve to confuse and mislead. The alleged high bioavailability of lead in Granite City soils is a theoretical argument. U.S. EPA has made no measure of the bioavailability of the soil at the Granite City site, nor has it considered the many other chemical and soil factors affecting the bioavailability of lead. In fact, the bulk of available data at smelter and urban sites indicates only a weak effect of soil lead on blood lead, which suggests low bioavailability or contact with soil,⁸ and the actual site-specific data for Granite City children does not show elevated blood lead concentrations. In addition, synergistic enhancement of lead's effects by other industrial pollutants is a completely unfounded argument. U.S. EPA does not cite what compounds to consider or any evidence that other contaminants synergize lead's toxicity. In fact, it is known that other metals can compete with lead for absorption and reduce lead's bioavailability and toxicity.

In summary, the central site-specific issues are: (i) whether or not current Granite City children's blood lead concentrations are elevated; and (ii) if elevated, what quantitative role does soil lead have, vis-a-vis other lead sources, in influencing blood lead concentrations. U.S. EPA failed to gather key site-specific information needed in order to develop a rational remediation decision for Granite City soils.⁹

⁸ In this regard, it should be noted that the OSWER interim guidance specifically states that "the Agency has not developed a position regarding the bioavailability issue . . ."

⁹ We note that one of the commenters to the ROD was Mr. Bobby G. Wixson, Dean of the College of Sciences, Clemson University, South Carolina. Mr. Wixson is the Chairman of the Society for
(continued...)

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U.S. EPA's 500 ppm remediation decision incorrectly predicts that there will be a substantial blood lead differential if soils are remediated to 500 ppm instead of 1,000 ppm, and its approach to estimating site-specific factors is overly generic and superficial. U.S. EPA completely disregarded valid quantitative approaches to setting a remediation standard (e.g., Uptake/Biokinetic Model using site-specific data) and, as a result, chose a remedy that was not cost-effective.¹⁰

III. U.S. EPA FAILED TO CONSIDER APPROPRIATE ALTERNATIVE REMEDIES

From its first entry into the Granite City area, Johnson Controls has sought to negotiate an appropriate course for remedial activities at the site. Noting the shortcomings in the record, the company offered to perform an environmental assessment of the Granite City area to address the relationship between soil lead and blood lead. More importantly, Johnson Controls offered to perform the remedy at the 500 ppm level if the study determined it appropriate. U.S. EPA did not consider the offer because the company refused to accept the deficient ROD.

In past weeks, the company again has explored other alternatives which could result in settlement. Believing that finding a cost-effective remedy is preferable to fighting about the agency's defective decision document, we suggested deep

⁹ (...continued)

Environmental Geochemistry and Health ("SEGH") Task Force on Lead in Soil. U.S. EPA is the funding agency for the SEGH Task Force and apparently commissioned the task force to determine guidelines for lead in soil. Mr. Wixson stressed in his comments that the task force remains convinced that a matrix approach to a site-specific location and population at risk be used rather than a single number or abatement approach applied to all sites. A draft of the SEGH Lead in Soil Task Force Recommended Guidelines recently was released confirming Mr. Wixson's belief that site-specific factors should be used in determining the appropriate cleanup level for a lead-contaminated site.

¹⁰ We note that paragraph 16 of the Order states that hazardous substances have and may continue to migrate through the air in the form of airborne emissions or dust. We also note that paragraph 26 of the Order states that the site "is or may be presenting an imminent and substantial endangerment to the public health or welfare or the environment." We are aware of no evidence to support these assertions.

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tilling and sodding as an alternative for soils in excess of 500 ppm but less than 1,000 ppm lead. Our initial study of the alternate remedy determined that it would cost at most one-third of the chosen remedy and perhaps lower depending on certain economies of scale. More importantly, it would reduce lead concentrations well below the 500 ppm level and would be a more permanent remedy than that U.S. EPA has chosen. Tilling also has considerable short-term advantages. It can be accomplished in a single year, does not endanger the neighborhood streets with heavy vehicles, causes little airborne particulate, and prevents complete disruption of the neighborhood.

In fact, the PRPs have documented evidence of the success of tilling in effectively reducing lead concentrations. In 1989, Exide Corporation, one the PRPs, contracted with WHO Manufacturing to perform soil cleanup and related remedial activities at Exide Corporation's facility in Selma, Alabama. The site was formerly used as a lead-acid battery manufacturing facility and regulated as a RCRA generator. Cleanup/remedial activities were performed by Exide on a voluntary basis and were based upon a plan submitted to the Alabama Department of Environmental Management (ADEM) and accepted in May 1988.

Decontamination objectives, as provided in the plan accepted by ADEM, were as follows:

1. To excavate contaminated soil (which exceeded an E.P. toxicity concentration of 5.0 mg Pb/l) and to dispose of the soil off-site,
2. For lesser contaminated soil (e.g., where E.P. toxicity concentrations were less than 5.0 mg Pb/l), to condition (till) the soil, and
3. Upon completion of items 1 and 2 above, to sample and analyze the soil (for total lead and E.P. toxicity for lead) in the areas where remedial measures were implemented to verify the success of remedial efforts.

Soil conditioning (tilling) was conducted in the lawn in front of the facility and in a surface drainage ditch located adjacent to the street in front of the facility. The attached sketch at the end of these comments shows the approximate location in which tilling was conducted. Surface soil samples were collected prior to and after remedial activities to evaluate the performance of the tilling process. Data from soil sampling are summarized as follows:

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Front Lawn

Lead Concentration in Soil (ppm, dry weight)

<u>Sampling Location</u>	<u>Before Tilling</u>	<u>After Tilling</u>
3-A-4	1,162	127
4-3	2,769	71.6
2-3	374	126
1-3	1,120	438
6-A-6		136
5-A-6	Range from	4.5
7-3	481 - 6,488	66.5

Drainage Ditch

Lead Concentration in Soil (ppm, dry weight)

<u>Sampling Location</u>	<u>Before Tilling</u>	<u>After Tilling</u>
8-A-4	3,350	22.1
9-A-5	1,699	107
10-A-4	3,055	29.4

A final report of the soil cleanup/remedial activities was submitted to ADEM by Exide Corporation on April 18, 1990. The substantial reductions in the soil lead levels above cannot be ignored.

Steven Siegel apparently has indicated that the remedy is mere dilution. Characterizing tilling in this manner results from a misunderstanding of basic science. As a nonradioactive, naturally occurring element, lead cannot and does not degrade through natural or man-made processes (high energy nuclear physics excepted), unlike many organic compounds often encountered at sites of concern. It becomes concentrated in the biosphere naturally through human use, and its concentration represents the material danger. The most immediate and permanent method for addressing such concentration is to reduce it, precisely what tilling like that discussed above accomplishes. We fail to see how creating a mountain of concentrated lead is preferable to our alternative.

The Minnesota Pollution Control Agency ("MPCA") has recently promulgated regulations stating that tilling is an acceptable remedial alternative for soil lead cleanup, and we understand another party has supplied you with them. While U.S.

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EPA has recently asserted that tilling was considered in the Remedial Investigation/Feasibility Study ("RI/FS") stage (although there is nothing in the record supporting this assertion), we understand U.S. EPA had previously told a PRP that it had not considered the method. Thus, we are at a loss regarding the agency's consideration of the issue. By ignoring a protective and cost-effective remedy, U.S. EPA failed to comply with the express requirements of CERCLA and the National Contingency Plan.¹¹

IV. U.S. EPA HAS IGNORED JOHNSON CONTROLS' DUE PROCESS RIGHTS

A. Johnson Controls was Added to the Process after U.S. EPA had Made its Decision

As evidenced during a December 18, 1990 meeting, U.S. EPA in fact made its decision about cleanup before it notified smelter site customers, including Johnson Controls, that they were PRPs at the site. By the time U.S. EPA asked Johnson Controls and other customers to participate, the RI/FS had been completed and modified by U.S. EPA. Customers of NL Industries then received a general notice letter in early December 1989, and, at the subsequent meeting on December 18, U.S. EPA informed the customers that they needed to organize a PRP group to implement the remedy U.S. EPA had already chosen. Further input on the company's part has been received without meaningful consideration. Johnson Controls has been deprived of the opportunity to play a meaningful role in the process and, as a result, also deprived of due process rights.

B. Johnson Controls did not Receive Proper Notice of the Comment Period

Johnson Controls did not receive proper notice of the comment period. Due process considerations require that reasonable notice be given to parties that may be affected by agency action. Johnson Controls and many of the other customers of NL Industries received written notice of the December 18, 1989 meeting with U.S. EPA through a general notice letter addressed to each individually. However, Johnson Controls never received comparable notice of the comment period which followed. Johnson Controls should have received notice of the comment period in a manner similar to the written notice it received for the December 18, 1989 meeting. Published notice was not sufficient because U.S. EPA had identified PRPs like Johnson Controls and knew their addresses. In fact, it is our understanding that U.S. EPA did

¹¹ It is not too late to give it the attention it deserves.

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not even publish notice in the Federal Register, the tool created over a half century ago to assure appropriate notice. By sheer accident, Johnson Controls found out about the comment period on the day it was extended, leaving insufficient time to reasonably respond to the proposed plan. Nevertheless, the company's comments did highlight the same shortcomings raised in this document -- problems which have yet to be cured.

C. The Deadlines in the Order are Unreasonable

The Order states that comments are due within 21 days of the issuance date or within 5 days of the conference with U.S. EPA, whichever is greater. U.S. EPA called counsel for Johnson Controls and told him that the conference would be held on December 21, making comments due on December 26. Given the Order carries with it draconian penalties for noncompliance, the deadline for comments is unreasonably short (and caused one to assume that the conference with U.S. EPA is not intended by the agency to serve any useful purpose other than to enable the agency to claim it had provided an opportunity to confer, meaningless as it may be). The deadline falls on the day after Christmas with an intervening weekend. Certain PRPs requested an extension until January 11 to submit comments to the Order on December 11, 1990, but the extension was rejected by U.S. EPA.

V. JOHNSON CONTROLS IS NOT A LIABLE PARTY UNDER CERCLA

The metal recycling business in the United States is centuries old. Customers of NL Industries and Taracorp brought materials to smelters for recycling, and such materials have served as raw materials long before any semblance of environmental control. Congress did not intend through CERCLA that such business relationships should be characterized as the arrangement for disposal or treatment of a hazardous substance. Consequently, smelter customers are not liable parties under CERCLA.

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VI. CONCLUSION

U.S. EPA's decision to remediate the soils in the residential areas to 500 ppm is arbitrary and capricious and not in compliance with law. With no pre-enforcement review and harsh penalties, CERCLA § 106 pushes the limits of due process. It is imperative that U.S. EPA properly justify and explain its remedial decision to ensure that a cost-effective remedy is chosen. U.S. EPA has cited studies which do not support its position and improperly used the U/B model. U.S. EPA has failed in this case to properly justify the 500 ppm standard for the Granite City site.

Very truly yours,

Dennis P. Reis

Dennis P. Reis

Enclosures

cc: Steve Siegel
Alan Held

EXIDE CORPORATION, SELMA, ALABAMA
SUMMARY OF SOIL CONDITIONING (TILLING) ACTIVITIES

Surface soil samples were collected prior to and after remedial activities to evaluate the performance of the tilling process. Data from soil sampling are summarized as follows:

Front Lawn

Lead Concentration in Soil (ppm, dry weight)

<u>Sampling Location</u>	<u>Before Tilling</u>	<u>After Tilling</u>
3-A-4	1,162	127
4-3	2,769	71.6
2-3	374	126
1-3	1,120	438
6-A-6		136
5-A-6	Range from	4.5
7-3	481 - 6,488	66.5

Drainage Ditch

Lead Concentration in Soil (ppm, dry weight)

<u>Sampling Location</u>	<u>Before Tilling</u>	<u>After Tilling</u>
8-A-4	3,350	22.1
9-A-5	1,699	107
10-A-4	3,055	29.4

FIELD INVESTIGATION REPORT
FOR GENERAL BATTERY CORPORATION'S SELMA, ALABAMA PLANT

Prepared for:
GENERAL BATTERY CORPORATION
READING, PENNSYLVANIA

Prepared by:
CH2M HILL
MONTGOMERY, ALABAMA

MG21279.AO
DECEMBER 1986

EXECUTIVE SUMMARY

The purposes of this report are to describe the sampling procedures and present the results of the sample analyses performed as a part of the site investigation at General Battery's inactive Selma, Alabama plant. During the field investigation, 132 soil, 30 stream sediment, 32 soil boring and 22 groundwater samples were collected.

Soil and sediment samples were analyzed for pH, total lead and extractable (EP) lead. Soil boring samples were analyzed for total and EP lead. Groundwater samples were analyzed for total and dissolved solids, sulfate, and total and soluble lead, cadmium, chromium and arsenic.

For soil samples, analytical results showed total lead values to range from less than 30 mg/kg to more than 90,000 mg/kg. EP lead values were as high as 700 mg/l. The highest soil lead levels occurred in the parking lot west of the plant. The lead levels generally decrease with distance from the plant.

Soil boring results showed decreasing lead concentration with depth. The highest total lead values were found in the borings directly north of the plant. At depths greater than nine feet, total lead levels were below analytical detection limits.

The results of the groundwater analyses showed total lead, chromium or arsenic levels sometimes exceeded EPA interim drinking water standards in any of the monitoring wells sampled. The only soluble metal value that exceeded interim drinking water standards was for lead on one occasion in Well 5.

All stream sediment samples had total lead levels below 200 mg/kg. EP lead results were all below 0.75 mg/l.

Chapter 1 INTRODUCTION

In February 1985, the General Battery Corporation (GBC) met with the Alabama Department of Environmental Management (ADEM) and agreed to conduct a site investigation at GBC's inactive Selma, Alabama, plant. The purpose of the site investigation was to determine the potential for offsite migration of contaminants by wind, surface runoff and groundwater.

The field investigation was performed using the general procedures specified in GBC's Monitoring Plan dated May 9, 1985 as modified by CH2M HILL's workplan of November 21, 1985. These plans were approved by the Alabama Department of Environmental Management (ADEM) on May 8, 1986. The workplans are attached as Appendix A.

Sampling included 132 soil samples, 66 each at the 0 to 3-inch and 3 to 6-inch depths, 30 stream sediment samples, 32 soil boring samples and 22 groundwater samples. During the project, the seven existing monitoring wells were supplemented by installation of four new groundwater monitoring wells.

In April 1986, GBC retained CH2M HILL to collect and analyze samples to be used as a data base for the site investigation. In July 1986, work began on the sample collection and continued until mid-August. The purposes of this report are to present the procedures used and results found during the data collection activities of the site investigation.

Chapter 2 PROCEDURES

SAMPLE LOCATIONS

All soil, stream sediment and monitor well locations are shown on Figure 1. Actual sample location procedures are given below.

Soil Samples

Soil samples were taken at or near the locations specified in GBC's Monitoring Plan. Actual sample locations were found relative to photo-identifiable objects or by compass-tape traversing.

The sample points near existing physical features were scaled off from the aerial photograph of the plant site. The sample location was then found by taping from the physical feature. Soil samples numbered 1 to 52 and 62 to 66 were located in this manner.

Sample points in heavily wooded areas were located by compass-tape traversing. The sample point was first located on the aerial photograph in relation to a baseline. The baseline was taken to be the Old Montgomery Highway, which intersects the railroad line on the southwest corner of the plant property.

The coordinates of photo-identifiable objects were calculated based on the magnetic inclination of the baseline. Sample points were then located by using compass readings and taped distances from the existing physical features. Soil samples 53-61 were located in this manner.

Sediment Samples

The drainage ways north of the plant are not easily distinguishable on the aerial photograph, therefore, the sediment sampling points were determined in the field. Each drainage course was traced using the compass-tape traverse technique described above. Samples were taken at the intervals specified in GBC's Monitoring Plan. All sediment samples were located in this manner.

Monitoring Wells

The four new monitoring wells (8,9,10, and 11) were located at or near the locations shown in GBC's Monitoring Plan by the tape-traverse method described above. During well installation, the location of monitor well 11 was moved south, toward the plant, approximately fifty feet in order to intercept groundwater. New and existing monitor well locations are shown on Figure 1.

SAMPLE COLLECTION

Soil Samples

Soil samples were collected from a surface area of approximately four square feet. The material overlying the sample area (gravel, grass, leaves) was cleared with a garden shovel or trowel. Four sample aliquots were taken to a depth of approximately 3 inches, one from each quadrant of the sample area, with a garden trowel. The aliquots were composited in an aluminum pan prior to being placed into a plastic bag and labeled with the project sample number.

The sample area was then cleared with a garden shovel or trowel to a depth of approximately 3 inches. Four sample aliquots were taken from a depth of approximately 3 to 6

inches, one from each quadrant of the sample area, with a garden trowel. The aliquots were composited and the sample placed in a plastic bag, then labeled with the project sample number.

All sampling equipment (shovels, trowels, pans) was brushed clean and decontaminated with distilled water after each use.

Stream Sediment Samples

Sediment samples were collected with garden trowels to a depth of approximately 3 inches. Samples were collected both above and below the water surface, depending upon actual stream conditions. Three to four aliquots were taken across the stream width and composited in a labeled plastic bag to make a sample. The sampling equipment was cleaned with distilled water after each use.

Soil Boring Samples

Soil sampling was performed by the hollow-stem auger method using a continuous sampler. Soil samples were taken at various intervals and placed in labeled glass jars. All sampling equipment was cleaned with distilled water after each use.

Groundwater Samples

Prior to well purging and sampling, water level measurements were taken. The volume of water contained in the well was then calculated. A minimum of three well volumes of water was purged prior to sampling. Teflon bailers were used to purge and sample each well.

During well purging, pH and temperature readings were measured and recorded periodically. Specific conductance of the well samples was either measured in the field or on the groundwater sample submitted to the laboratory.

The pH meter was calibrated using a two point calibration at pH 4 and 7 before each sampling event. The conductivity meter was standardized against a solution of known conductivity before each use.

All sampling equipment that contacted groundwater was rinsed with distilled water after each use. New rope was used for each well sampled.

Groundwater samples were poured from the bailer into appropriately preserved sample containers supplied by the laboratory. The sample to be analyzed for dissolved metals was placed into an unpreserved sample bottle. The unpreserved sample was filtered through a 0.45 micron filter pad at the laboratory and placed into a sample bottle containing the appropriate preservative.

The results of one groundwater sampling event (8/15/86) were voided due to apparent cross contamination during sample filtration. The wells were resampled on 9/4/86. Analytical results for the these samples are included in this report.

MONITORING WELL INSTALLATION

All wells were constructed of 2-inch (ID) flushed-threaded PVC pipe and screen placed in an approximate 6-inch diameter borehole. Screens were 5 feet in length and placed across the zone of saturation.

The screened interval was sand packed and a bentonite seal was placed above the sand. The remaining annulus was grouted to the surface with a cement-bentonite mix. A locking steel cover was seated in the grout and a concrete pad was placed around the well. The wells were developed by hand pumping until suspended solids were minimized.

Typical well construction details are shown in Figure 2. Actual well installation details are presented in Figure 3. The monitoring well boring logs are included as Appendix B.

Table 1 summarizes the new monitoring well construction data. The elevations given are based upon an assumed surface elevation of 146.4 feet at Monitor Well 4 as provided by GBC.

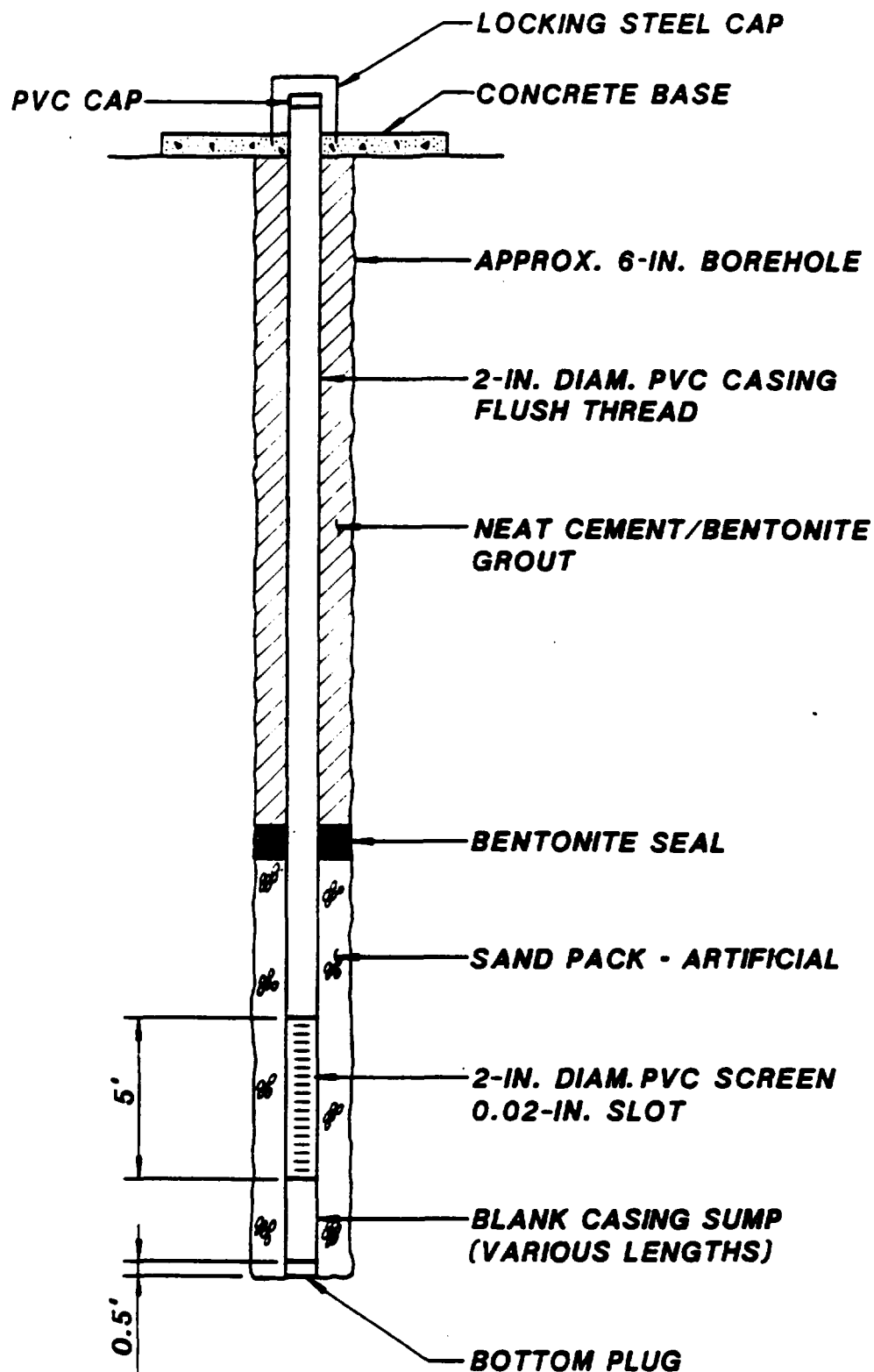
LABORATORY SUBMITTALS .

Initially, all stream sediment samples and the shallow (0-3") soil samples were submitted to the laboratory for analysis according to the schedule below:

<u>Sample Type</u>	<u>Analytical Parameters</u>		
	<u>pH</u>	<u>Total Lead</u>	<u>EP Lead</u>
Soil (0-3")	X	X	X
Stream Sediment		X	X

The 3 to 6-inch soil samples were held, pending the results of the 0 to 3-inch soil sample analyses.

After the analysis of 34 samples (soil samples 1-34) the lowest total lead concentration that resulted in an extractable lead concentration near the EP Toxicity limit of



**FIGURE 2:
TYPICAL WELL
CONSTRUCTION DETAIL**



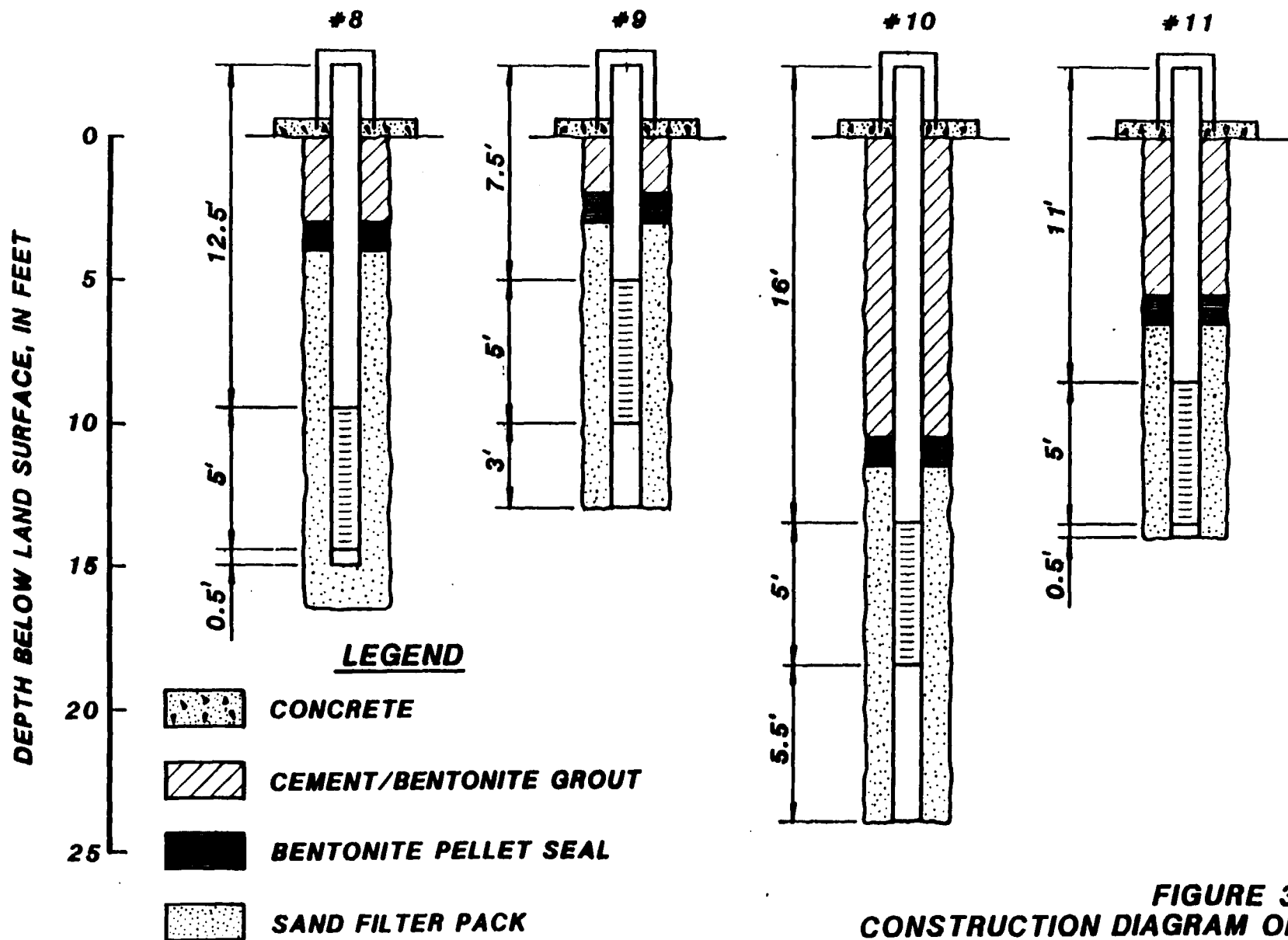


FIGURE 3:
CONSTRUCTION DIAGRAM OF
WELLS 8,9,10,&11, GENERAL BATTERY
CORPORATION - SELMA, AL PLANT



Table 1
SUMMARY OF WELL CONSTRUCTION DATA
GENERAL BATTERY CORPORATION
SELMA, ALABAMA PLANT
WELLS INSTALLED 7/15-7/16/86

Well No.	PVC Casing Stickup (ft)	Depth in Feet From Top of PVC Casing to:			Elevation (ft)*			
		Screen Top	Screen Bottom	Casing Bottom	Casing Top	Land Surface	Screen Top	Casing Bottom
8	3.0	12.5	17.5	18.0	145.2	142.2	132.7	127.2
9	2.5	7.5	12.5	15.5	144.9	142.4	137.4	129.4
10	2.5	16.0	21.0	26.5	153.1	150.6	137.1	126.6
11	2.5	11.0	16.0	16.5	150.9	148.4	139.9	134.4

*Based on a surface elevation of 146.4' at Monitor Well 4, as provided by General Battery.

5 mg/l was approximately 600 mg/kg. Therefore, in order to speed the laboratory analysis program, the following procedures were followed:

- o Analyze all samples for EP lead that were already extracted
- o Analyze any unextracted samples for EP lead if the total lead value was 300 mg/kg or greater
- o Analyze any 3 to 6-inch sample for pH, total lead, and extractable lead if the corresponding shallow sample had a total lead value greater than 500 mg/kg

ANALYTICAL PROCEDURES

Samples were collected, preserved and analyzed in accordance with Methods of Chemical Analysis of Water and Wastes, U.S. EPA, Cincinnati, Ohio, EPA-600/4-79-020, 1979) or Test Methods for Evaluating Solid Wastes (SW-846). Procedures and Method numbers are listed in Table 2.

During the analysis of General Battery samples, the laboratory followed a regular quality control (QC) schedule of laboratory duplicate and spike sample analyses. A spike and duplicate sample was run with each batch of samples. Laboratory QC results are given in Appendix C.

Table 2
ANALYTICAL PROCEDURES USED DURING THE ANALYSIS OF
GENERAL BATTERY SAMPLES

<u>Procedure</u>	<u>EPA Method No.</u>
Digestion	3020 ¹
EP Extraction	1310 ¹
Lead	239.1 ² , 239.2 ²
Cadmium	213.1 ² , 213.2 ²
Chromium	218.1 ² , 218.2 ²
Arsenic	206.2 ²
Soil pH	*
TSS	160.2 ²
TDS	160.1 ²
Sulfate	375.4 ²

¹SW-846

²EPA-600 4-79-020

*Procedure of "Hydrogen Ion Activity" in Methods of Soil Analysis by C.A. Black (American Society of Agronomy, 1965).

Chapter 3 RESULTS

SOIL SAMPLES

The 0 to 3-inch and 3 to 6-inch soil sample analytical results are presented in Tables 3 and 4, respectively. The total and EP lead results for the 0 to 3-inch samples are presented graphically in Figures 4 and 5, respectively. Total and EP lead results for the 3 to 6-inch samples are presented graphically in Figures 6 and 7, respectively.

Figures 4 through 7 present the results in order-of-magnitude ranges. The EP lead ranges were chosen to be multiples of the EP toxicity limit of 5 mg/l. The total lead ranges were arbitrarily chosen to be multiples of 50 mg/kg.

Figures 4 and 6 show that total lead values are highest on the plant property for both the 0 to 3-inch and 3 to 6-inch depths. For both depths, total lead values generally decrease with distance from the plant. Highest lead levels are in the parking lot west of the plant for both the 0 to 3-inch and 3 to 6-inch samples.

Figures 5 and 7 show similar results for EP lead levels. The EP lead values greater than the EP toxicity limit of 5 mg/l are on the plant property for both the 0 to 3-inch and 3 to 6-inch samples.

SEDIMENT SAMPLES

Table 5 presents analytical results for the sediment samples collected at GBC's Selma plant. Figure 8 shows the total lead results graphically.

Table 3 (continued)

SAMPLE NUMBER*		SAMPLE DESCRIPTION	SAMPLE DATE	ANALYTICAL RESULTS		
PROJECT	LAB			pH (S.U.)	TOTAL LEAD (MG/KG)	EP LEAD (MG/L)
68-S-34 -A	7746-27	Soil, 0"-3" Depth	6/25/86	5.9	194	3.10
68-S-35 -A	7746-29	Soil, 0"-3" Depth	6/25/86	4.7	116	<0.08
68-S-36 -A	7746-31	Soil, 0"-3" Depth	6/25/86	5.6	139	<0.08
68-S-37 -A	7746-33	Soil, 0"-3" Depth	6/25/86	5.0	128	<0.08
68-S-38 -A	7746-35	Soil, 0"-3" Depth	6/25/86	7.8	294	0.59
68-S-39 -A	7746-37	Soil, 0"-3" Depth	6/25/86	5.7	26	0.11
68-S-40 -A	7746-39	Soil, 0"-3" Depth	6/25/86	5.7	28	0.92
68-S-41 -A	7746-41	Soil, 0"-3" Depth	6/25/86	5.8	76	<0.08
68-S-42 -A	7746-43	Soil, 0"-3" Depth	6/25/86	5.1	56	<0.08
68-S-43 -A	7746-45	Soil, 0"-3" Depth	6/25/86	5.2	44	<0.08
68-S-44 -A	7746-47	Soil, 0"-3" Depth	6/25/86	5.4	107	<0.08
68-S-45 -A	7746-49	Soil, 0"-3" Depth	6/25/86	6.6	16	<0.08
68-S-46 -A	7746-51	Soil, 0"-3" Depth	6/25/86	6.2	45	<0.08
68-S-47 -A	7746-53	Soil, 0"-3" Depth	6/25/86	7.5	66	<0.08
68-S-48 -A	7746-55	Soil, 0"-3" Depth	6/25/86	5.7	179	0.78
68-S-49 -A	7746-57	Soil, 0"-3" Depth	6/25/86	6.0	60	<0.08
68-S-50 -A	7761-1	Soil, 0"-3" Depth	6/27/86	5.4	77	<0.08
68-S-51 -A	7761-3	Soil, 0"-3" Depth	6/27/86	6.5	132	<0.08
68-S-52 -A	7761-5	Soil, 0"-3" Depth	6/27/86	5.7	85	<0.08
68-S-53 -A	7768-1	Soil, 0"-3" Depth	6/30/86	5.5	79	<0.08
68-S-54 -A	7768-3	Soil, 0"-3" Depth	6/30/86	5.5	310	<0.08
68-S-55 -A	7768-5	Soil, 0"-3" Depth	6/30/86	4.4	120	<0.08
68-S-56 -A	7768-7	Soil, 0"-3" Depth	6/30/86	6.6	71	<0.08
68-S-57 -A	7779-1	Soil, 0"-3" Depth	7/01/86	5.0	169	---
68-S-58 -A	7779-3	Soil, 0"-3" Depth	7/01/86	6.8	322	<0.08
68-S-59 -A	7779-5	Soil, 0"-3" Depth	7/01/86	6.5	67	---
68-S-60 -A	7779-7	Soil, 0"-3" Depth	7/01/86	5.5	83	---
68-S-61 -A	7779-9	Soil, 0"-3" Depth	7/01/86	6.4	310	<0.08
68-S-62 -A	7779-11	Soil, 0"-3" Depth	7/01/86	6.3	701	0.12
68-S-63 -A	7779-13	Soil, 0"-3" Depth	7/01/86	5.6	628	<0.08
68-S-64 -A	7779-15	Soil, 0"-3" Depth	7/01/86	5.4	1005	<0.08
68-S-65 -A	7779-17	Soil, 0"-3" Depth	7/01/86	5.9	177	---
68-S-66 -A	7779-19	Soil, 0"-3" Depth	7/01/86	5.8	50	---

*Project Sample Number=68-T-###-D; where 68=Project (General Battery), T=Sample Type (S=Soil, B=Boring, W=Water), ###=Sample Point Number, D=Depth of Sample (Soil: A=0"-3"; B=3'-6"; Boring: Actual Depth; Water: N/A).

---Collected but not analyzed.

Table 3
GENERAL BATTERY-SELMA: SOIL SAMPLE ANALYTICAL RESULTS (0-3")

SAMPLE NUMBER*		SAMPLE DESCRIPTION	SAMPLE DATE	ANALYTICAL RESULTS		
PROJECT	LAB			pH (S.U.)	TOTAL LEAD (MG/KG)	EP LEAD (MG/L)
6B-S- 1 -A	7746-1	Soil, 0"-3" Depth	6/25/86	6.0	182	4.00
6B-S- 2 -A	7746-3	Soil, 0"-3" Depth	6/25/86	6.8	9822	68.80
6B-S- 3 -A	7746-5	Soil, 0"-3" Depth	6/25/86	7.2	24344	23.40
6B-S- 4 -A	7746-7	Soil, 0"-3" Depth	6/25/86	7.4	5922	13.00
6B-S- 5 -A	7746-9	Soil, 0"-3" Depth	6/25/86	7.4	13064	315.00
6B-S- 6 -A	7746-11	Soil, 0"-3" Depth	6/25/86	8.1	1398	7.70
6B-S- 7 -A	7746-13	Soil, 0"-3" Depth	6/25/86	7.1	83100	734.00
6B-S- 8 -A	7746-15	Soil, 0"-3" Depth	6/25/86	7.6	59660	698.00
6B-S- 9 -A	7746-17	Soil, 0"-3" Depth	6/25/86	8.1	1901	175.00
6B-S-10 -A	7746-19	Soil, 0"-3" Depth	6/25/86	7.9	1214	3.80
6B-S-11 -A	7746-21	Soil, 0"-3" Depth	6/25/86	7.9	20980	586.00
6B-S-12 -A	7746-23	Soil, 0"-3" Depth	6/25/86	8.2	1469	2.60
6B-S-13 -A	7739-1	Soil, 0"-3" Depth	6/24/86	5.8	481	0.97
6B-S-14 -A	7739-3	Soil, 0"-3" Depth	6/24/86	5.8	11212	15.00
6B-S-15 -A	7739-5	Soil, 0"-3" Depth	6/24/86	5.3	3412	8.20
6B-S-16 -A	7739-7	Soil, 0"-3" Depth	6/24/86	6.0	1162	4.60
6B-S-17 -A	7739-9	Soil, 0"-3" Depth	6/24/86	6.2	374	0.76
6B-S-18 -A	7739-11	Soil, 0"-3" Depth	6/24/86	5.4	578	5.50
6B-S-19 -A	7739-13	Soil, 0"-3" Depth	6/24/86	6.0	3350	0.22
6B-S-20 -A	7739-15	Soil, 0"-3" Depth	6/24/86	6.5	1699	<0.08
6B-S-21 -A	7739-17	Soil, 0"-3" Depth	6/24/86	7.1	3054	0.23
6B-S-22 -A	7739-19	Soil, 0"-3" Depth	6/24/86	6.8	573	0.43
6B-S-23 -A	7739-21	Soil, 0"-3" Depth	6/24/86	7.0	432	0.19
6B-S-24 -A	7739-23	Soil, 0"-3" Depth	6/24/86	6.1	93	0.15
6B-S-25 -A	7739-25	Soil, 0"-3" Depth	6/24/86	6.5	328	0.65
6B-S-26 -A	7739-27	Soil, 0"-3" Depth	6/24/86	7.6	1870	5.00
6B-S-27 -A	7739-29	Soil, 0"-3" Depth	6/24/86	7.1	706	0.15
6B-S-28 -A	7739-31	Soil, 0"-3" Depth	6/24/86	6.5	329	0.13
6B-S-29 -A	7739-33	Soil, 0"-3" Depth	6/24/86	6.3	359	0.19
6B-S-30 -A	7739-35	Soil, 0"-3" Depth	6/24/86	6.0	364	0.27
6B-S-31 -A	7739-37	Soil, 0"-3" Depth	6/24/86	7.2	174	0.12
6B-S-32 -A	7739-39	Soil, 0"-3" Depth	6/24/86	7.8	370	0.76
6B-S-33 -A	7746-25	Soil, 0"-3" Depth	6/25/86	6.4	885	0.28

*Project Sample Number=6B-T-###-D; where 6B=Project (General Battery), T=Sample Type (S=Soil, B=Boring, W=Water),
###=Sample Point Number, D=Depth of Sample (Soil: A=0-3"; B=3-6"; Boring: Actual Depth; Water: N/A).

---Collected but not analyzed.

Table 4

GENERAL BATTERY-SELMA: SOIL SAMPLE ANALYTICAL RESULTS (3'-6")

SAMPLE NUMBER*		SAMPLE DESCRIPTION	SAMPLE DATE	ANALYTICAL RESULTS		
PROJECT	LAB			pH (S. U.)	TOTAL LEAD (MG/KG)	EP LEAD (MG/L)
68-S- 1 -B	7746-2	Soil, 3'-6" Depth	6/25/86	---	---	---
68-S- 2 -B	7746-4	Soil, 3'-6" Depth	6/25/86	6.7	1702	0.21
68-S- 3 -B	7746-6	Soil, 3'-6" Depth	6/25/86	6.8	2858	4.20
68-S- 4 -B	7746-8	Soil, 3'-6" Depth	6/25/86	6.3	26040	3.70
68-S- 5 -B	7746-10	Soil, 3'-6" Depth	6/25/86	6.7	27895	0.24
68-S- 6 -B	7746-12	Soil, 3'-6" Depth	6/25/86	7.8	2074	6.20
68-S- 7 -B	7746-14	Soil, 3'-6" Depth	6/25/86	6.6	91140	0.84
68-S- 8 -B	7746-16	Soil, 3'-6" Depth	6/25/86	6.2	1681	39.00
68-S- 9 -B	7746-18	Soil, 3'-6" Depth	6/25/86	5.7	96	0.20
68-S-10 -B	7746-20	Soil, 3'-6" Depth	6/25/86	6.9	50	<0.08
68-S-11 -B	7746-22	Soil, 3'-6" Depth	6/25/86	7.9	5294	27.00
68-S-12 -B	7746-24	Soil, 3'-6" Depth	6/25/86	7.6	153	0.12
68-S-13 -B	7739-2	Soil, 3'-6" Depth	6/24/86	5.6	22	<0.08
68-S-14 -B	7739-4	Soil, 3'-6" Depth	6/24/86	6.0	129	<0.08
68-S-15 -B	7739-6	Soil, 3'-6" Depth	6/24/86	5.0	30	<0.08
68-S-16 -B	7739-8	Soil, 3'-6" Depth	6/24/86	5.6	132	<0.08
68-S-17 -B	7739-10	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-18 -B	7739-12	Soil, 3'-6" Depth	6/24/86	5.2	153	<0.08
68-S-19 -B	7739-14	Soil, 3'-6" Depth	6/24/86	6.3	653	0.19
68-S-20 -B	7739-16	Soil, 3'-6" Depth	6/24/86	6.2	193	<0.08
68-S-21 -B	7739-18	Soil, 3'-6" Depth	6/24/86	7.4	2104	0.17
68-S-22 -B	7739-20	Soil, 3'-6" Depth	6/24/86	6.2	258	<0.08
68-S-23 -B	7739-22	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-24 -B	7739-24	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-25 -B	7739-26	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-26 -B	7739-28	Soil, 3'-6" Depth	6/24/86	7.0	215	0.34
68-S-27 -B	7739-30	Soil, 3'-6" Depth	6/24/86	6.2	230	<0.08
68-S-28 -B	7739-32	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-29 -B	7739-34	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-30 -B	7739-36	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-31 -B	7739-38	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-32 -B	7739-40	Soil, 3'-6" Depth	6/24/86	---	---	---
68-S-33 -B	7746-26	Soil, 3'-6" Depth	6/25/86	6.1	878	<0.08

*Project Sample Number=68-T-###-D; where 68=Project (General Battery), T=Sample Type (S=Soil, B=Boring, W=Water), ###=Sample Point Number; D=Depth of Sample (Soil: A=0-3"; B=3-6"; Boring: Actual Depth; Water: N/A).

---Collected but not analyzed.

Table 4 (continued)

SAMPLE NUMBER*		SAMPLE DESCRIPTION	SAMPLE DATE	ANALYTICAL RESULTS		
PROJECT	LAB			pH (S. U.)	TOTAL LEAD (MG/KG)	EP LEAD (MG/L)
GB-S-34 -B	7746-28	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-35 -B	7746-30	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-36 -B	7746-32	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-37 -B	7746-34	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-38 -B	7746-36	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-39 -B	7746-38	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-40 -B	7746-40	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-41 -B	7746-42	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-42 -B	7746-44	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-43 -B	7746-46	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-44 -B	7746-48	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-45 -B	7746-50	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-46 -B	7746-52	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-47 -B	7746-54	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-48 -B	7746-56	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-49 -B	7746-58	Soil, 3'-6" Depth	6/25/86	---	---	---
GB-S-50 -B	7761-2	Soil, 3'-6" Depth	6/27/86	---	---	---
GB-S-51 -B	7761-4	Soil, 3'-6" Depth	6/27/86	---	---	---
GB-S-52 -B	7761-6	Soil, 3'-6" Depth	6/27/86	---	---	---
GB-S-53 -B	7768-2	Soil, 3'-6" Depth	6/30/86	---	---	---
GB-S-54 -B	7768-4	Soil, 3'-6" Depth	6/30/86	---	---	---
GB-S-55 -B	7768-6	Soil, 3'-6" Depth	6/30/86	---	---	---
GB-S-56 -B	7768-8	Soil, 3'-6" Depth	6/30/86	---	---	---
GB-S-57 -B	7779-2	Soil, 3'-6" Depth	7/01/86	---	---	---
GB-S-58 -B	7779-4	Soil, 3'-6" Depth	7/01/86	---	---	---
GB-S-59 -B	7779-6	Soil, 3'-6" Depth	7/01/86	---	---	---
GB-S-60 -B	7779-8	Soil, 3'-6" Depth	7/01/86	---	---	---
GB-S-61 -B	7779-10	Soil, 3'-6" Depth	7/01/86	---	---	---
GB-S-62 -B	7779-12	Soil, 3'-6" Depth	7/01/86	6.4	364	0.10
GB-S-63 -B	7779-14	Soil, 3'-6" Depth	7/01/86	5.2	508	0.15
GB-S-64 -B	7779-16	Soil, 3'-6" Depth	7/01/86	5.0	503	<0.08
GB-S-65 -B	7779-18	Soil, 3'-6" Depth	7/01/86	---	---	---
GB-S-66 -B	7779-20	Soil, 3'-6" Depth	7/01/86	---	---	---

*Project Sample Number=GB-T-###-D; where GB=Project (General Battery), T=Sample Type (S=Soil, B=Boring, W=Water),
 ###=Sample Point Number; D=Depth of Sample (Soil: A=0-3"; B=3-6"; Boring: Actual Depth; Water: N/A).

---Collected but not analyzed.

Table 5

GENERAL BATTERY-SELMA: SEDIMENT SAMPLE ANALYTICAL RESULTS

SAMPLE NUMBER*		SAMPLE DESCRIPTION	SAMPLE DATE	ANALYTICAL RESULTS		
PROJECT	LAB			pH (S.U.)	TOTAL LEAD (MG/KG)	EP LEAD (MG/L)
6B-S-67	7761-7	Sediment	6/27/86	5.4	19	<0.08
6B-S-68	7761-8	Sediment	6/27/86	5.3	57	<0.08
6B-S-69	7761-9	Sediment	6/27/86	5.2	169	<0.08
6B-S-70	7761-10	Sediment	6/27/86	5.4	13	<0.08
6B-S-71	7761-11	Sediment	6/27/86	8.2	20	<0.08
6B-S-72	7761-12	Sediment	6/27/86	7.9	17	<0.08
6B-S-73	7761-13	Sediment	6/27/86	7.8	61	<0.08
6B-S-74	7761-14	Sediment	6/27/86	8.3	18	0.20
6B-S-75	7761-15	Sediment	6/27/86	8.2	14	0.08
6B-S-76	7761-16	Sediment	6/27/86	7.9	65	<0.08
6B-S-77	7761-17	Sediment	6/27/86	7.6	13	<0.08
6B-S-78	7761-18	Sediment	6/27/86	8.1	13	<0.08
6B-S-79	7768-9	Sediment	6/30/86	8.3	21	0.31
6B-S-80	7768-10	Sediment	6/30/86	8.3	34	0.72
6B-S-81	7768-11	Sediment	6/30/86	5.0	80	---
6B-S-82	7768-12	Sediment	6/30/86	5.1	16	---
6B-S-83	7768-13	Sediment	6/30/86	4.5	85	---
6B-S-84	7768-14	Sediment	6/30/86	5.3	148	---
6B-S-85	7768-15	Sediment	6/30/86	5.6	57	---
6B-S-86	7768-16	Sediment	6/30/86	5.6	27	---
6B-S-87	7768-17	Sediment	6/30/86	5.2	78	---
6B-S-88	7779-21	Sediment	7/1/86	7.7	18	---
6B-S-89	7779-22	Sediment	7/1/86	7.6	18	---
6B-S-90	7779-23	Sediment	7/1/86	8.0	18	---
6B-S-91	7779-24	Sediment	7/1/86	7.8	89	---
6B-S-92	7779-25	Sediment	7/1/86	5.8	39	---
6B-S-93	7779-26	Sediment	7/1/86	7.9	68	---
6B-S-94	7779-27	Sediment	7/1/86	7.6	46	---
6B-S-95	7779-28	Sediment	7/1/86	7.8	151	---
6B-S-96	7779-29	Sediment	7/1/86	7.2	22	---

*Project Sample Number=6B-T-###-D; where 6B=Project (General Battery), T=Sample Type (S=Soil, B=Boring, W=Water), ###=Sample Point Number, D=Depth of Sample (Soil: A=0-3"; B=3-6"; Boring: Actual Depth; Water: N/A).

---Collected but not analyzed.

The maximum observed total lead concentration was less than 500 mg/kg. No concentration pattern is apparent. High and low total lead values are randomly distributed down the stream lengths.

EP lead results are not presented graphically since all values are below 1 mg/l. Only four of fourteen values were above the detection limit of 0.08 mg/l.

SOIL BORINGS

Soil boring analytical results are presented in Table 6 and on the soil boring logs, Appendix A. High total lead values were found north of the plant at Boring 9 where the soil boring sample from 0.5 to 1.0 foot depth contained approximately six percent total lead by weight.

Generally, the total lead concentrations are highest near ground surface and decrease with depth. Samples from depths of nine feet or more had total lead levels less than the detection limit of 8 mg/kg.

Three samples were analyzed for EP lead. Only one sample had a detectable concentration (0.20 mg/l).

GROUNDWATER SAMPLES

Table 7 summarizes groundwater field sampling data. During the one-time sampling of all monitoring wells, wells 2, 3, 4, 6 and 7 were either dry or contained insufficient volume to sample.

Groundwater analytical data are given in Table 8. Several lead (total and soluble), arsenic (total) and chromium (total) concentrations exceed EPA's interim primary drinking

Table 6
GENERAL BATTERY-SELMA: SOIL BORING ANALYTICAL RESULTS

SAMPLE NUMBER*		SAMPLE DESCRIPTION	ANALYTICAL RESULTS		
PROJECT	LAB		SAMPLE DATE	TOTAL LEAD (MG/KG)	EP LEAD (MG/L)
GB-B- 1 -3	7892-1	Monitor Well 8 @ 3'-4' Depth	7/15/86	19	---
GB-B- 2 -9	7892-2	Monitor Well 8 @ 9'-11' Depth	7/15/86	<8	---
GB-B- 5 -14	7892-3	Monitor Well 8 @ 14'-16' Depth	7/15/86	<8	---
GB-B- 6 -16	7892-4	Monitor Well 8 @ 16'-16.5' Depth	7/15/86	<8	---
GB-B-13 -0.5	7892-5	Monitor Well 11A @ 0.5'-1' Depth	7/15/86	944	<0.08
GB-B-15 -4.5	7892-6	Monitor Well 11A @ 4.5'-5' Depth	7/15/86	27	---
GB-B-16 -6.5	7892-7	Monitor Well 11A @ 6.5'-7' Depth	7/15/86	23	---
GB-B-17 -9.5	7892-8	Monitor Well 11A @ 9.5'-10' Depth	7/15/86	<8	---
GB-B-18 -12.5	7892-9	Monitor Well 11A @ 12.5'-13' Depth	7/15/86	<8	---
GB-B-19 -1.5	7892-10	Monitor Well 10 @ 1.5'-2' Depth	7/16/86	199	---
GB-B-20 -3.5	7892-11	Monitor Well 10 @ 3.5'-4' Depth	7/16/86	51	---
GB-B-23 -9	7892-12	Monitor Well 10 @ 9'-9.5' Depth	7/16/86	<8	---
GB-B-25 -18.5	7892-13	Monitor Well 10 @ 18.5'-19' Depth	7/16/86	<8	---
GB-B-26 -20	7892-14	Monitor Well 10 @ 20'-20.5' Depth	7/16/86	<8	---
GB-B-28 -0.5	7892-15	Monitor Well 9 @ 0.5'-1' Depth	7/16/86	58600	0.20
GB-B-30 -4.5	7892-16	Monitor Well 9 @ 4.5'-5' Depth	7/16/86	1188	<0.08
GB-B-32 -8	7892-17	Monitor Well 9 @ 8'-8.5' Depth	7/16/86	19	---

*Project Sample Number=GB-T-###-D; where GB=Project (General Battery), T=Sample Type(S=Soil, B=Boring, W=Water), ###=Sample Point Number, D=Depth of Sample(Soil: A=0-3", B=3-6"; Boring: Actual Depth; Water: N/A).
---Collected but not analyzed.

Table 7
GROUNDWATER FIELD SAMPLING DATA

Well	Date	Water Level Elev. (ft)*	Final pH (S.U.)	Final Conductivity (umhos/cm)	Purge Volume (gal)
1	8/1/86	145.4**	5.88	75	8.0
2	8/1/86	Dry	---	---	---
3	8/1/86	Dry	---	---	---
4	8/1/86	Dry	---	---	---
5	8/1/86	137.0**	5.55	40	3.0
6	8/1/86	Dry	---	---	---
7	8/1/86	Dry	---	---	---
8	7/24/86	140.2	6.93	210	7.0
8	8/1/86	139.8	7.27	170	6.0
8	8/8/86	140.0	6.69	160	9.0
8	8/15/86	139.6	7.07	160	6.0
8	9/4/86	139.9	7.09	140	6.0
9	7/24/86	137.5	7.32	340	4.0
9	8/1/86	137.1	7.22	200	3.5
9	8/8/86	137.4	6.90	180	4.0
9	8/15/86	135.7	6.95	180	3.5
9	9/4/86	139.1	6.90	190	4.8
10	7/24/86	136.8	7.05	370	4.0
10	8/1/86	136.5	6.71	370	4.5
10	8/8/86	136.6	6.58	350	4.0
10	8/15/86	136.5	6.59	---	4.5
10	9/4/86	136.3	6.48	360	4.5
11	7/24/86	137.8	7.11	280	2.0
11	8/1/86	137.7	6.75	300	1.3
11	8/8/86	138.2	7.18	420	1.5
11	8/15/86	138.0	6.48	410	1.5
11	9/4/86	137.8	6.65	480	1.5

*Based on a surface elevation of 146.4' at Monitor Well #4,
as provided by General Battery.

**Assumes same PVC casing stickup as for Monitor Well #4.

Table 8
GENERAL BATTERY-SELMA: GROUNDWATER SAMPLING RESULTS

SAMPLE NUMBER*		SAMPLE DESCRIPTION	SAMPLE DATE	FIELD RESULTS		ANALYTICAL RESULTS (MG/L)											
PROJECT	LAB			p.H. (S.U.)	COND. (UMHO/CM)	TSS	TDS	SD4	Pb-T	Pb-S	Cd-T	Cd-S	As-T	As-S	Cr-T	Cr-S	
GB-M- 5	7918-1	Monitoring Well 1	8/1/86	5.88	75	4024	96	8	0.440	0.002	0.003	<0.001	0.110	<0.003	0.150	<0.002	
GB-M- 9	7918-5	Monitoring Well 5	8/1/86	5.55	40	293	92	6	2.400	0.061	<0.001	<0.001	0.006	<0.003	0.068	<0.002	
GB-M- 1	7901-1	Monitoring Well 8	7/24/86	6.93	210	40	128	7	0.100	0.002	<0.001	<0.001	<0.008	<0.008	0.004	0.003	
GB-M- 8	7918-4	Monitoring Well 8	8/1/86	7.27	170	129	160	7	0.140	<0.002	<0.001	<0.001	0.005	<0.003	0.043	<0.002	
GB-M-11	7943-1	Monitoring Well 8	8/8/86	6.69	160	215	157	8	<0.08	<0.002	<0.001	<0.001	0.006	<0.003	0.050	<0.002	
GB-M-17	7967-3	Monitoring Well 8 (VOID)	8/15/86	7.07	160	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	
GB-M-19	8023-1	Monitoring Well 8	9/4/86	7.09	141	283	143	3	0.013	<0.005	0.002	0.001	0.01	<0.005	0.05	<0.001	
GB-M- 2	7901-2	Monitoring Well 9	7/24/86	7.32	340	4374	157	7	1.500	<0.002	0.001	<0.001	0.050	<0.008	0.180	<0.001	
GB-M-10	7918-6	Monitoring Well 9	8/1/86	7.22	200	6551	182	7	4.400	0.020	0.005	<0.001	0.130	<0.003	0.420	<0.002	
GB-M-12	7943-2	Monitoring Well 9	8/8/86	6.90	180	3755	202	10	1.100	0.003	0.001	0.001	0.090	<0.003	0.200	<0.002	
GB-M-18	7967-4	Monitoring Well 9 (VOID)	8/15/86	6.95	180	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	
GB-M-20	8023-2	Monitoring Well 9	9/4/86	6.90	190	2414	170	3	1.7	<0.005	0.008	0.006	0.07	<0.005	0.16	<0.001	
GB-M- 3	7901-3	Monitoring Well 10	7/24/86	7.05	370	6604	308	9	0.240	0.004	0.002	<0.001	0.060	<0.008	0.260	0.001	
GB-M- 6	7918-2	Monitoring Well 10	8/1/86	6.71	370	4998	350	72	0.380	---	0.005	---	0.110	---	0.240	---	
GB-M-13	7943-3	Monitoring Well 10	8/8/86	6.58	350	2145	314	72	0.150	0.002	0.001	0.001	0.060	<0.003	0.100	<0.002	
GB-M-16	7967-2	Monitoring Well 10 (VOID)	8/15/86	6.59	---	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	
GB-M-21	8023-3	Monitoring Well 10	9/4/86	6.48	360	1266	282	23	0.069	<0.005	0.003	0.002	0.07	<0.005	0.11	0.001	
GB-M- 4	7901-4	Monitoring Well 11	7/24/86	7.11	280	1215	215	13	0.150	<0.002	<0.001	<0.001	<0.008	<0.008	0.036	<0.001	
GB-M- 7	7918-3	Monitoring Well 11	8/1/86	6.75	300	336	306	21	0.048	0.012	0.002	<0.001	0.017	<0.003	0.063	<0.002	
GB-M-14	7943-4	Monitoring Well 11	8/8/86	7.18	420	469	351	18	<0.08	0.003	0.002	<0.001	0.013	<0.003	0.061	<0.002	
GB-M-15	7967-1	Monitoring Well 11 (VOID)	8/15/86	6.48	410	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	
GB-M-22	8023-4	Monitoring Well 11	9/4/86	6.65	480	184	331	9	0.012	<0.005	0.004	0.001	0.03	0.008	0.05	<0.001	

*Project Sample Number=GB-T-000-D; where GB=Project (General Battery), T=Sample Type(S=Soil, B=Boring, N=Water), 000=Sample Point Number, D=Depth of Sample(Soil: A=0-3"; B=3-6"; Boring: Use Actual Depth; Water: N/A).

water standards for these metals. These standards are given below.

<u>Parameter</u>	<u>Maximum Level (mg/l)</u>
Arsenic	0.05
Cadmium	0.01
Chromium	0.05
Lead	0.05

Wells 9 and 10 most often exceeded the interim standards. This is probably due to their location, downgradient by elevation from the plant parking lot where the highest lead levels were found in soil samples.

Total lead concentrations in the groundwater samples were at least two orders of magnitude (100 x) greater than the dissolved concentrations. This indicates that the lead is adsorbed to the solids in the sample.

APPENDIX A

GENERAL BATTERY CORPORATION'S
MONITORING PLAN AND CH2M HILL WORKPLAN

GENERAL BATTERY CORPORATION
MONITORING PLAN
FOR
INACTIVE BATTERY MANUFACTURING FACILITY
SELMA, ALABAMA

GENERAL BATTERY CORPORATION
DEPARTMENT OF ENVIRONMENTAL RESOURCES
P. O. BOX 1262
READING, PENNSYLVANIA 19603

MAY 9, 1985

1.0 INTRODUCTION

1.1 Background

General Battery Corporation (GBC) and the Alabama Department of Environmental Management (ADEM), in a meeting held in ADEM offices on February 1, 1985, have agreed to conduct an assessment of environmental conditions at GBC's inactive battery manufacturing facility in Selma, Alabama. The completion of this work will be undertaken as follow-up to the inactive site assessment performed by Environmental Protection Systems, Inc., under contract to ADEM, pursuant to the RCRA 3012 program.

1.2 Scope

The information set forth in this document describes the proposed GBC plan for completing the evaluation of existing environmental conditions at the GBC Selma facility.

1.3 Objectives

The purposes of this study are to:

- a. Determine and evaluate the concentrations of lead in the surface soils at the facility and surrounding areas, and
- b. Determine and evaluate the concentrations of metals in groundwater at the facility and the potential for off-site migration.

Identification of lead concentrations in surface soils will be completed to evaluate the potential for off-site movement via surface runoff trenches and by atmospheric deposition.

2.0 AERIAL PHOTOGRAPH

In order to precisely define existing site conditions, GBC contracted with CH2M-Hill in Montgomery, Alabama to perform an aerial photograph of the GBC Selma facility and surrounding areas. This photograph will form the basis upon which further studies will be completed. Reproductions of this photograph are attached as Figures 1 and 2 to this document.

Figures 1 and 2 have been marked in yellow to show the approximate locations of streams and drainage courses adjacent to the facility. As the aerial photograph does not clearly define the stream locations at several points, the stream designations which are shown on Figures 1 and 2 should be viewed as approximate locations only, subject to field verification.

3.0 EVALUATION OF LEAD CONCENTRATIONS IN SURFACE SOILS

3.1 Sampling Locations

Soil samples will be collected at the approximate locations shown in Figure 1. The concentric circle approach to sampling will be used to determine the variation in lead concentration with increasing distance from the GBC facility in an attempt to evaluate lead concentrations in soil which may have resulted from atmospheric deposition. Locations which have been selected in drainage trenches will allow an evaluation to be made of the impact, if any, of stormwater runoff from the site.

Other locations have been selected to determine the concentration of lead in soils adjacent to roadways and to determine the concentration of lead in soil at the playground adjacent to the local school.

3.2 Soil sampling procedure

Cylindrical soil cores (approximately 3/4 inch diameter) will be collected at each on-site sampling location to a depth of 6 inches below the surface using a stainless steel, hand-driven Hankinson soil sampling tube (Model #A20A) or equivalent. A minimum of four soil cores will be collected at each location within a two foot square area to produce a sufficient quantity of soil for analysis. At each sampling point, soil samples will be collected from the locations within the 2-foot square area which are determined to have the least overlying vegetation.

Upon removal of the soil core, each sample will be fractionated into "A" and "B" series. The "A" series will represent cores which will be collected at a depth of 0-3 inches, while the "B" series will represent the portion of the core which is collected from a depth of 3-inches below the surface.

In the event that soil conditions prevent the use of the soil sampling tube at a given location, soil samples will be collected with a garden shovel at the specified locations and depths.

Sampling equipment will be cleaned and washed with distilled water between samples in the field to prevent potential contamination of soil samples.

For samples collected at off-site locations, the same sampling protocol will be used, except that only one sample will be collected at each location from a depth of 0-3 inches below the surface. In the event that the 0-3 inch sample is tested and is analyzed to contain an unacceptable level of contamination, additional samples will be collected to define the lead concentration at increased depths.

3.3 Sample Containers

Samples will be packaged in new plastic sample bags or bottles, labeled, stored at room temperature, and forwarded to the laboratory for analysis. Sample containers will be marked to identify the sample location, number, and sample depth.

3.4 Soil Analysis Procedures

Following collection and packaging, soil samples will be delivered to AGES Laboratories in Norristown, Pennsylvania or another EPA-certified laboratory for analysis. All samples will be dried in the laboratory to constant weight at 105°C. After drying, the soil will be screened through a stainless steel 16-mesh sieve with the aid of a glass pestle. The unsieved portion (e.g., pebbles and vegetation) will be discarded. Soil will be analyzed for total lead using the nitric acid digestion procedure in "Test Methods for Evaluating Solid Wastes" (SW-846) and for extractable lead using the EPA Extraction Procedure (45 Federal Register 33127-33129). For verification of soil pH conditions, samples will be analyzed for pH according to Chapter 60.3, "Hydrogen Ion Activity," in Methods of Soil Analysis by C. A. Black (American Society of Agronomy, 1965). A copy of the soil pH procedure is attached to this document in Appendix 1.

All lead analyses will be performed using atomic absorption spectrophotometric methods.

3.5 Chain of Custody Control

The person who physically collects the soil samples will be responsible for completion of the Chain of Custody Record, an example of which is shown in Appendix 2. The Chain of Custody record will accompany the samples until receipt at the laboratory when it will be signed by the authorized laboratory representative and returned to General Battery Corporation.

3.6 Quality Control

The analytical laboratory will be required to document its internal quality control procedures and the results of routine daily quality control checks made while the samples from this study were being analyzed.

4.0 EVALUATION OF METAL CONCENTRATIONS IN GROUNDWATER AND SUBSURFACE S

4.1 Groundwater Well Locations

A series of new groundwater monitoring wells will be installed at approximate locations shown in Figure 2. The locations of monitoring wells have been selected as previous studies have identified the groundwater flow gradient at the site to be in a south-to-north direction. Groundwater monitoring well locations are shown as approximate locations only, as it may be necessary to adjust these sites to allow access for installation equipment.

4.2 Monitoring Wells - Scope of Work

Details on the scope of work to be performed in this phase of the project are specified as follows:

- a. The monitoring well bore hole will be a minimum diameter of 8-inches and will be capable of accommodating the installation of 4-inch diameter PVC casing and screen, a graded sand pack, and a protective steel casing as shown on Exhibit 1 on the following page.
- b. Two monitoring wells will be installed at each location. Unless otherwise determined at the time of drilling, one well (designated as "A") shall be drilled to a depth of 30 feet below the surface and the second well (designated as "B") shall be drilled to a depth of 60 feet.
- c. During the well installation, the contractor's driller will maintain a detailed log of procedures used, materials encountered, and general comments concerning the advance of each well bore. Samples of drill cuttings will be obtained at 5-foot intervals and will be packaged and delivered to General Battery Corporation, 645 Penn Street, Reading, Pennsylvania 19601. Samples will subsequently be transferred to AGES Laboratories in Norristown, Pennsylvania (or another authorized laboratory) for total lead and extractable lead analysis in accordance with the protocol detailed in Section 3 of the monitoring plan.
- d. Upon monitoring well completion, each well shall be developed to yield clear water when pumped. Development shall consist of pumping or airlift/surging procedures.

4.3 Monitoring Well Installation Details

Installation details for the monitoring wells are specified as follows:

- a. Upon completion of drilling of each well, the contractor will provide and install PVC casing and screen from the bottom of the hole to 2.5 feet above the ground surface. The casing and screen will be 4-inch I.D. Schedule 40 plastic pipe containing threaded flush joint connections. The use of PVC solvent to join sections of casing or screen together will not be permitted. The screen shall have a slot size of 0.02 inches.

TYPICAL MONITORING WELL INSTALLATION DETAIL
GENERAL BATTERY CORP.

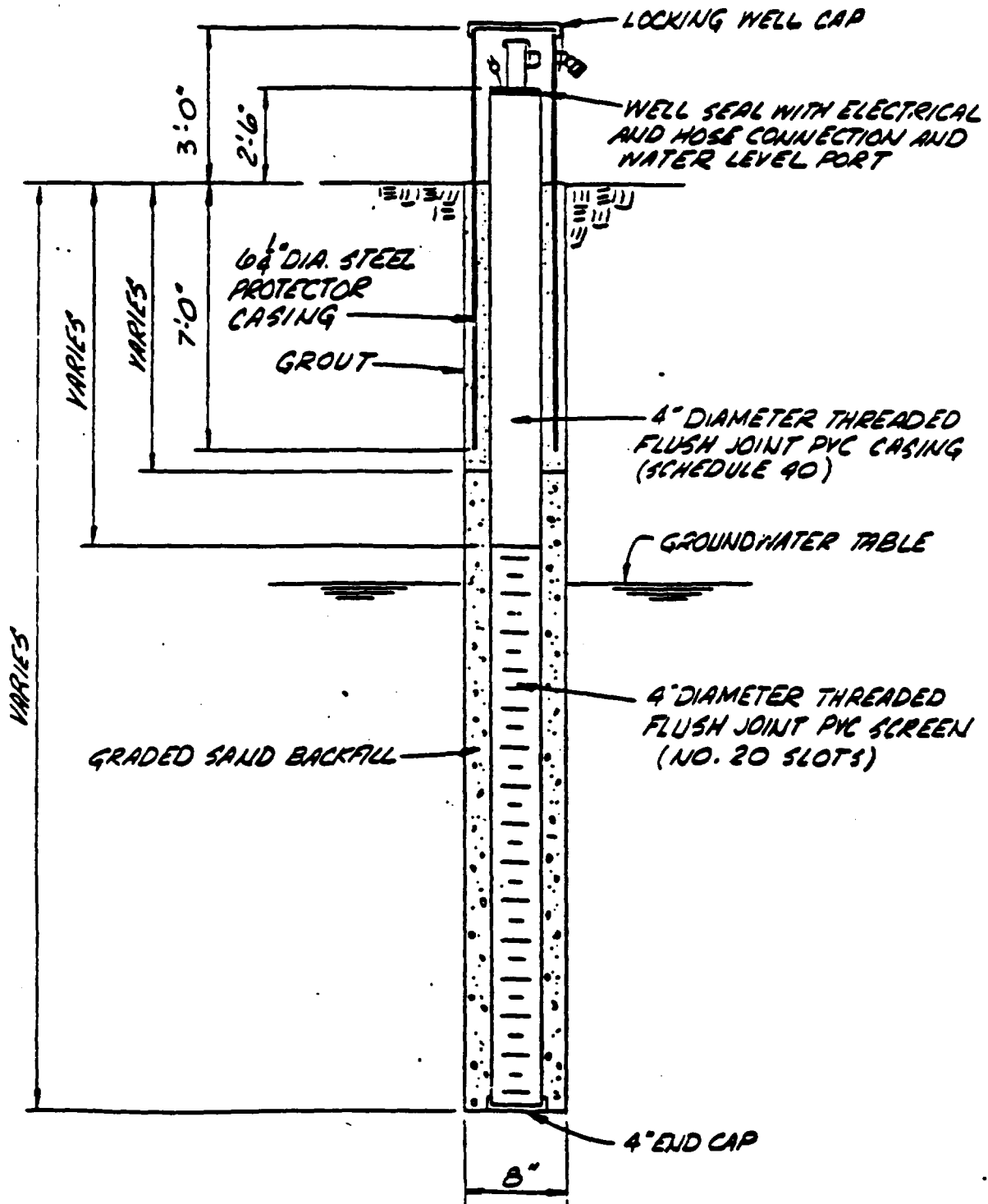


EXHIBIT 1

- b. Unless otherwise determined at the time of drilling, the contractor shall install the PVC screen in the monitoring wells at the following intervals:
 - (1) "A" series wells - 20 to 30 feet.
 - (2) "B" series wells - 50 to 60 feet.
- c. The contractor will provide and install a threaded PVC cap at the bottom of each well screen.
- d. After casing and screen installation, the annular space between the 4-inch PVC screen and well bore will be backfilled with a graded sand. The sand will be free from clay, silt, vegetation or other substances determined to be deleterious and shall be chemically inert. The sand will be of sufficient size to prevent passage through the PVC screen, but allow tight tangential packing within the annular space between the open drill hole and the PVC screen.
- e. Unless otherwise determined at the time of drilling, the graded sand will be placed at the following intervals:
 - (1) "A" series wells - 15 to 30 feet.
 - (2) "B" series wells - 45 to 60 feet.
- f. The annular space between the well bore and the 4-inch PVC casing will be grouted from the top of the graded sand backfill to the surface. The grout mix will consist of Portland Cement or equivalent and water mixed at a ratio of 1 bag of cement per 5 to 8 gallons of water.
- g. The contractor will provide and install a steel protector casing in each well. The protector casing will be 10 feet long and have a minimum diameter of 6-inches.
- h. Each monitoring well will have a locking well cap.

4.4 Installation of Monitoring Well Pumps

Each well will be equipped with a dedicated pump which will be installed according to the following specifications:

- a. The contractor will provide and install a submersible pump unit in each well. Each submersible pump unit will be equipped with a 115 volt, single phase 1/3 HP motor.
- b. The submersible pump unit will be installed at a setting 5 feet above the bottom of each well screen.

The riser or discharge pipe will be 1-inch diameter, or larger, flexible plastic pipe of standard thickness.

- c. Drop cable will be 2 wire, size 10, 12, or 14 AWG Franklin Electrical Cable or equal. The drop cable will be taped to the discharge pipe at 5 foot intervals.

- d. The contractor will provide and install a well seal in each monitoring well. Each well seal will contain an electrical connector, a flexible hose connection and a water level reading port.

4.5 Measurement of Groundwater Elevation

Prior to collection of a sample for analysis, the distance between the ground surface and the top of the water table will be measured. The water table depth will be determined relative to the ground surface elevation by measuring the total length of dry line to the top of the well casing minus the height of the casing above the ground surface.

4.6 Groundwater Purging/Evacuation

Prior to collection of a groundwater sample for analysis, groundwater will be removed from the monitoring well by pumping and discarding each sample so that the water flows downslope away from the monitoring well. Since it is generally assumed that the standing water in the well prior to sampling is not representative of true groundwater, it is necessary to remove the estimated volume of water in the well, discard these samples, and allow the well to recharge with infiltrating groundwater. Soil conditions will influence the rate at which the well is recharged, therefore, the time needed between purging and sampling to allow for recharging with groundwater is site specific and can only be determined on the basis of previous experience. Care will be taken to prevent resuspension of sediment which may have accumulated at the bottom of the monitoring well. Prior to collection of a sample, the sample bottle will be rinsed several times and the rinsewater will be discarded.

The extent of preliminary purging will be dependent upon many variables, including the local hydrology, therefore, correct procedures will need to be evaluated on a site-specific basis. Evacuation of a minimum of one volume of water from the well casing and preferably three to five well volumes will be performed to ensure collection of a representative sample.

For monitoring wells which can be purged to dryness with the sampling equipment, the well will be purged and allowed to recharge prior to sample withdrawal. When possible, evacuation of more than one well volume will be performed. If possible, samples will be collected immediately after well recovery.

For monitoring wells which cannot be purged to dryness with the sampling equipment, the volume of water evacuated from the well will be three to five times the total volume of water standing in the well.

Data collected during the purging procedure will be recorded in a field notebook for future reference.

4.7 Groundwater Sampling

After pumping the required volume and allowing the well to recharge,

the same procedure will be used to collect a sample of groundwater for analysis. A clean, labeled sample bottle will be filled with water for analysis.

As soon as practical after sample collection, the pH and conductivity of the groundwater will be recorded in the field, using portable equipment.

Field conditions and data will be recorded in a notebook for future reference.

4.8 Preservation of Samples, Containers, and Sample Volumes

As soon as practical following collection of samples from the monitoring wells, the samples will be delivered to an authorized laboratory or preserved in accordance with established procedures. Samples to be analyzed for total metals will be acidified with nitric acid to a pH of less than 2.0. Samples to be tested for dissolved metals will be filtered prior to acidification.

Preservation of samples, container types, and sample volumes will be performed in accordance with established U.S. Environmental Protection Agency procedures as detailed in Table 1. (Methods for Chemical Analysis of Water and Wastes, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA-600 4-79-020, 1979).

4.9 Laboratory Analysis

Groundwater samples will be analyzed in the laboratory as soon as possible following collection.

During the first month of groundwater sampling, samples will be collected from the new wells on a weekly basis and will be analyzed for the following parameters:

1. pH (field)
2. Specific conductance (field)
3. Total solids
4. Dissolved solids
5. Sulfates
6. Total lead
7. Dissolved lead
8. Total cadmium
9. Dissolved cadmium
10. Total arsenic

11. Dissolved arsenic
12. Total chromium
13. Dissolved chromium

During the sampling of the new wells in the first month of sampling, one series of samples from the existing wells will be collected and analyzed for the parameters specified above.

Should successive samples from the new wells verify that the metal concentrations are present in concentrations less than the National Interim Primary Drinking Water Standards, the metal(s) would be deleted from subsequent analyses.

Following the completion of analyses from the first month of sampling, groundwater sampling would continue to be performed on a quarterly basis during discussions between General Battery Corporation and the Alabama Department of Environmental Management.

4.10 Chain of Custody Control

Chain of custody procedures will be followed for groundwater samples collected from monitoring wells. Procedures will be followed as described in Section 3.5.

4.11 Quality Control

The analytical laboratory will be required to document its internal quality control procedures and the results of routine daily quality control checks made while the samples from this study were being analyzed.

5.0 PROJECT MEETINGS WITH ADEM

Upon receipt of analytical data from the laboratory and compilation by General Battery Corporation, it is the desire of GBC to meet with ADEM staff to review data, interpret the significance and meaning of the data, and, if necessary, develop a program for continued study. Project meetings would be scheduled at a mutually convenient time to the Alabama Department of Environmental Management and General Battery Corporation.

Section II PROJECT APPROACH

As stated in Section I, based on our knowledge of the site and regional geology, we are proposing a modified work plan to that specified in the May 9, 1985, Monitoring Plan. We feel that this modified plan would adequately achieve the desired objectives of the May 9th Plan, but at a much reduced cost. In our Cost of Services section, we have included cost estimates for both the May 9, 1985, Monitoring Plan and our modified work plan.

PROPOSED SCOPE OF WORK

Task 1. Project Kick-Off and Information Exchange

Immediately following contract award, CH2M HILL will schedule a kick-off meeting or conference call with our key project staff and GBC personnel. The objectives of this meeting or conference call will be to confirm specific project objectives, approach, and schedule and to exchange any additional site data or information.

Task 2. Locating Soil and Steam Bed Sediment Sampling Points

A majority of soil and sediment sampling points will be located using existing physical landmarks, existing aerial photos and maps, a measuring tape, range finder, and compass. It is felt that using these methods most sampling points can be located within plus or minus 10 feet. For those locations where these methods are impractical (i.e., deep forest locations on the 500 and 700-ft radius north and east of the site), transit survey techniques will be used. While all sample points could be located using standard surveying techniques, due to site terrain and heavy over

growth on and surrounding the site, sampling point location cost using standard surveying techniques would be 3 to 4 times that of the above proposed method.

Task 3. Near Surface Soil and Stream Bed Sediment Sampling

Following sampling point location and marking, samples will be collected from the 66 soil sampling locations, and the 20 sediment sampling locations indicated on Figure 1 of the Request for Proposal (RFP). Our field reconnaissance revealed that the stream bed actually divides adjacent to the plant and we propose an additional 5 sampling points to better characterize sediments in the stream bed. Samples will be collected and composited according to procedures outlined in Sections 3.0-3.6 of the May 9, 1985, Monitoring Plan. Since the incremental cost of collecting the 3-6 inch depth samples while collecting the 0-3 sample is relatively low, we propose to collect both samples at all 66 soil sampling locations, in order to reduce the possibility of having to resample. Initially however, we will only submit for analysis the 0-3 depth sample from each sampling location.

Using our Montgomery, Alabama, laboratory for analysis, provides us with the flexibility to have ongoing review of the data as it is generated to rapidly determine whether the 3-6 inch depth sample requires analysis. By following this procedure, we can reduce the possibility of resampling and hold analytical cost to a minimum.

Task 4. Monitor Well Installation

The objective is to install groundwater monitoring wells to provide adequate water for analysis of groundwater quality in the first aquifer beneath the facility.

Due to the potential cost savings, we propose to install wells as shown in Figure A. The borings will be drilled using 6-inch O.D. hollow stem augers to the top of the Selma Chalk geologic unit and/or a minimum depth of 6 feet below the water table encountered at the time of drilling. Soil samples will be taken continuously by the split-spoon method as per ASTM-D1586 for the entire depth of drilling. Soil samples for chemical analysis will be collected at 5 ft intervals. Upon reaching the required depth, soil cuttings will be removed from the borehole and the well screen and casing assembly set in place through the hollow stem auger.

The augers will be raised approximately 7 feet while the well screen is allowed to remain on the bottom of the borehole. Natural sand and gravel will be allowed to collapse in around the well screen to develop a natural sand/gravel pack. If the natural sand and gravel do not collapse to a point at least 1 foot above the top of the well screen, graded sand will be poured down the hollow stem to bring the level of the sand pack to 1 foot above the screened section.

A bentonite seal, at least 1 foot thick, will be placed immediately above the sand/gravel pack. Cement grout will be placed above the bentonite seal to ground surface by pumping it into the hollow stem as the augers are removed from the borehole. A protective steel casing with locking cap will be grouted in place in the annulus. After the grout has been allowed to set overnight, the wells will be developed by surging and pumping until clear, sediment free water is produced from the well.

Task 5. Groundwater Sampling

Prior to well sampling, standing water level elevations will be measured and recorded. Next, the wells will be purged by



SUBJECT Peppard wells for
General Battery & Seima

BY Shannon DATE 11-10-85

SHEET NO. 1

PROJECT NO. MG 692.33

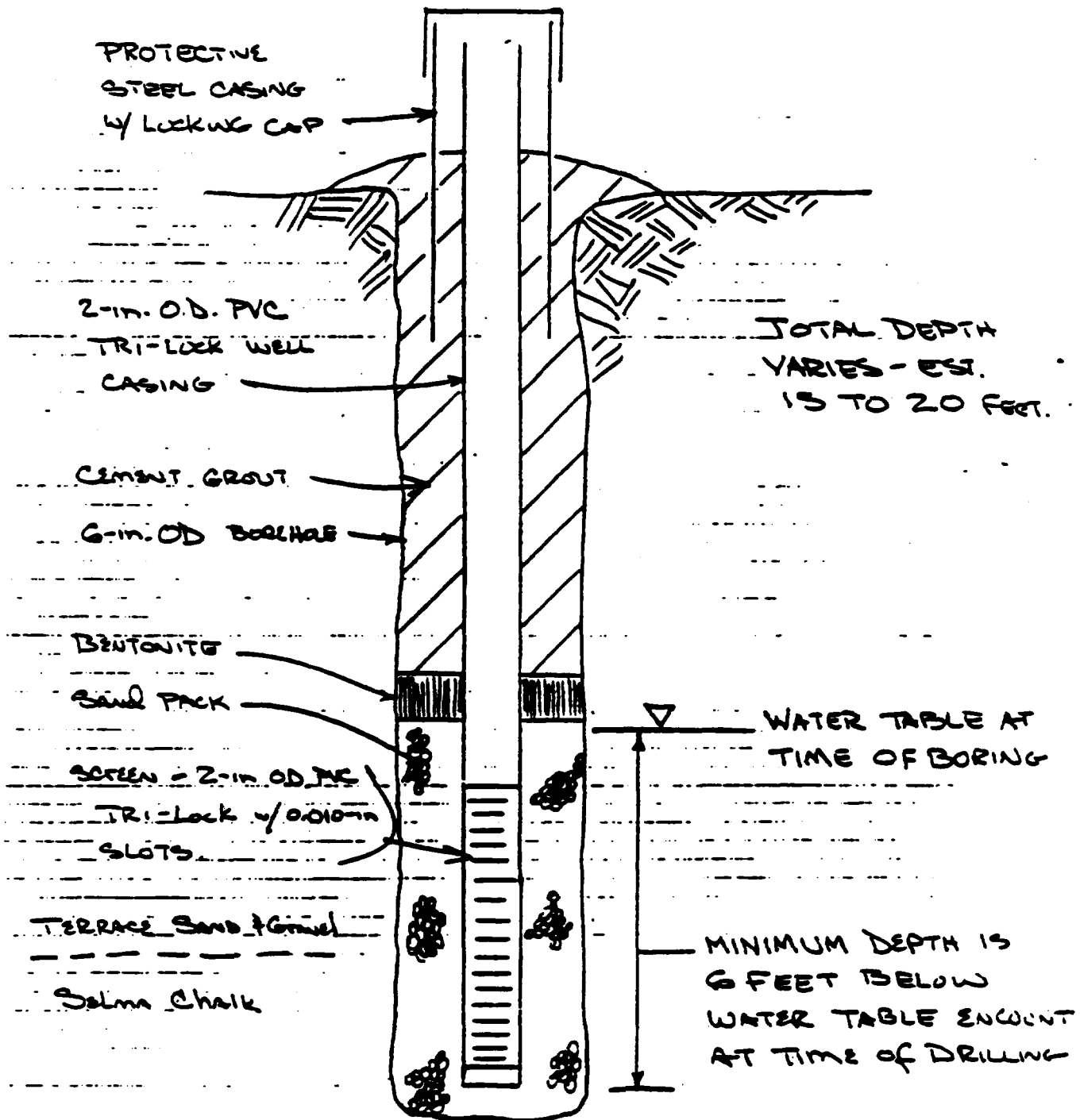


FIGURE A: MONITORING WELL DETAIL

bailing or pumping using a bladder or peristaltic pump. Sufficient water will be purged to draw water into the well from a 1/4 to 1 foot radius beyond the sand/gravel pack to provide a representative formation water sample. If the wells do not produce at a flow rate adequate to maintain pumping, a minimum of 3 to 5 well volumes will be removed (purged) from the well prior to sampling.

Following adequate presample purging, groundwater samples will be collected using teflon bailers.

For the first month following well completion, the new wells will be sampled weekly. In addition, during this first month, one round of samples will be collected from the seven existing wells. Following the initial first month, monitoring well samples will be collected from all wells on a quarterly basis.

Sample preservation, chain of custody, analysis and laboratory quality control will be followed as specified in Sections 4.6 through 4.11 of the RFP.

Task 6. Sample Analysis

CH2M HILL is proposing to use our Montgomery, Alabama laboratory rather than the laboratory identified in the RFP.

Task 7. Final Report

Upon completion of all laboratory analyses, a final report will be prepared summarizing and presenting the data. As budgeted, this report would be a single submittal presenting the data without extensive interpretation as to site conditions. If desired by GBC, we could provide interim reports during the project presenting the data as it is

5

generated. However, costs for preparing interim reports was not included in the budget estimate for this proposal.

Task 8. Attendance at Meetings With GBC and ADEM

Included in the cost of services section is an estimate of the cost for key project personnel to attend up to two meeting with GBC and ADEM.

Task 9. Quarterly Sampling

Quarterly sampling and analysis will be performed on all wells during negotiations between GBC and ADEM.

APPENDIX B

MONITOR WELL BORING LOGS
GENERAL BATTERY CORPORATION - SELMA, ALABAMA PLANT



PROJECT NUMBER MG 21279 AO	BORING NUMBER WELL 8	SHEET 1 OF 2
SOIL BORING LOG		

PROJECT GENERAL BATTERY LOCATION SELMA, AL
ELEVATION _____ DRILLING CONTRACTOR TTL, TUSCALOOSA, AL
DRILLING METHOD AND EQUIPMENT CME 55, HOLLOW-STEM AUGER
WATER LEVEL AND DATE _____ START 7-15-86 FINISH 7-15-86 LOGGER M.T. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			SOIL DESCRIPTION <small>NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL</small>	SYMBOLIC LOG	COMMENTS <small>DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION</small>
		INTERVAL	TYPE AND NUMBER	RECOVERY <small>Pb (PPM) (TOTAL / EP)</small>			
	1				<u>SAND, BROWN (DISTURBED BY DOZER)</u>		<u>5' CONTINUOUS CORE - SAMPLER</u>
	2						
	3						
	4		1	(19/--)			
	5				<u>NO SAMPLES, BUT DRILLED SOFT - PROBABLY SAND, WET</u>		<u>WET @ 5'-6', AS AUGERED</u>
	6						
	7						
	8						
	9				<u>SAND, DARK BROWN TO BLACK, FINE TO MEDIUM GRAINED SAND WITH < 5% QUARTZ PEBBLES, SOFT, WET</u>		
	10		2	4' (<8/--)			
	11		3		<u>SAND, LIGHT GRAY, FINE TO MEDIUM GRAINED, WELL SORTED, UNIFORM, WET, SOFT</u>		
	12		4		<u>SAND, LIGHT BROWN, FINE TO MEDIUM GRAINED, GRAVEL AT BASE</u>		
	13						
	14						
	15		5	(<8/--)	<u>SAND, FINE TO COARSE GRAINED WITH MINOR GRAVEL (<5%), LIGHT BROWN</u>		



PROJECT NUMBER

MG 21279 A0

BORING NUMBER

WELL 8


SHEET 2 OF 2

SOIL BORING LOG

PROJECT GENERAL BATTERYLOCATION SELMA, AL

ELEVATION _____

DRILLING CONTRACTOR TTL, TUSCALOOSA, ALDRILLING METHOD AND EQUIPMENT CME 55, HOLLOW-STEM AUGERWATER LEVEL AND DATE _____ START 7-15-86 FINISH 7-15-86 LOGGER M.T. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			LEAD (PPM) (TOTAL/ EP)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		INTERVAL	TYPE AND NUMBER	RECOVERY				
16			6		(48/--) T.D.	CLAY, DARK GREEN, PLASTIC @ 16'		WELL 2" CASING & SCREEN TO 15' b.i.s. SCREEN IS SET @ 9 1/2' - 14 1/2' SAND PACK TO 4' b.i.s. AROUND SCREEN BENTONITE PELLETS TO 3', GROUT TO SURFACE 3' STICKUP STEAM CLEANED 1/2 HR. PUMP 1 DRUM OF WATER TO DEVELOP, CLEAR



PROJECT NUMBER

MQ 21279 A0

BORING NUMBER

9

SHEET / OF /

SOIL BORING LOG

PROJECT GENERAL BATTERYLOCATION SELMA, AL

ELEVATION

DRILLING CONTRACTOR

TTL, TUSCALOOSA, AL

DRILLING METHOD AND EQUIPMENT

CME 55, HOLLOW-STEM AUGER

WATER LEVEL AND DATE

START

7-16-86

FINISH

7-16-86

LOGGER

M.T. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			LEAD (PPM) (TOTAL EP)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		INTERVAL	TYPE AND NUMBER	RECOVERY				
	1		28		(58600/ 0.20)	SAND, DARK BROWN, DISTURBED BY DOZER, DRY, ORGANIC ROOTS, MINOR PEBBLES AT 2'		WELL 2" PVC 3' SUMP SCREEN SET 5'- 10'
	2			3'				2 1/2' CUT OFF
	3		29					2 1/2' STICK UP
	4					SAND, DARK BROWN TO BLACK, LIGNITIC, DRY, WET AT 4 1/2' - 5'		18' STRING
	5		30		(1188/ 40.08)			STEAM CLEANING 1/2 HR.
	6			4'		SAND, LIGHT GRAY TO LIGHT BROWN, FINE TO MEDIUM GRAINED, WET		TOP OF CLAY ESTIMATED FROM DRILLING
	7		31					
	8		32		(19/--)	SAND, LIGHT GRAY, PEBBLES AT 10' ABOVE CLAY		
	9							
	10			1'				
	11							
	12					CLAY, DARK GRAY/GREEN, STIFF		
	13							



PROJECT NUMBER MG 21279 AD	BORING NUMBER 10	SHEET 1 OF 2
SOIL BORING LOG		

PROJECT GENERAL BATTERY LOCATION SELMA, AL
ELEVATION _____ DRILLING CONTRACTOR TTL, TUSCALOOSA, AL
DRILLING METHOD AND EQUIPMENT CME 55, HOLLOW-STEM AUGER
WATER LEVEL AND DATE _____ START 7-16-86 FINISH 7-16-86 LOGGER M.T. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			LEAD (PPM) (TOTAL/ EP)	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
		INTERVAL	TYPE AND NUMBER	RECOVERY		NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		
1						SAND, DARK BROWN TO BLACK AT 1', DRY, ORGANIC RICH, FINE TO MEDIUM GRAINED		
2			19	4'	(199/--)			
3						SAND, RUST, DRY, FINE TO MEDIUM GRAINED		
4			20		(51/--)	CLAY, GRAY/RED, MOTTLED, STIFF, PLASTIC, DRY		
5								
6			21	3'		SAND, FINE TO COARSE GRAINED, BROWN, VARIABLE COLORS, PEBBLES AT 6 1/2' TO 7', DRY		
7			22					
8								
9			23		(48/--)	SAND, BROWN, AS ABOVE WITH PEBBLES 5-10%, MEDIUM TO COARSE GRAINED, DAMP		
10								
11			24	2'				
12						SAND, LIGHT GRAY TO WHITE, MEDIUM GRAINED, DAMP		
13								
14				2'				
15								



PROJECT NUMBER

MG 21279 A0

BORING NUMBER

10

SHEET 2 OF 2

SOIL BORING LOG

PROJECT GENERAL BATTERYLOCATION SELMA, ALELEVATION _____ DRILLING CONTRACTOR TTL, TUSCALOOSA, ALDRILLING METHOD AND EQUIPMENT CME 55, HOLLOW-STEM AUGERWATER LEVEL AND DATE _____ START 7-16-86 FINISH 7-16-86 LOGGER M.T. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			LEAD (PPM) (TOTAL/ EP)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		INTERVAL	TYPE AND NUMBER	RECOVERY				
16						SAND, SILTY, GREEN/GRAY, WITH PEBBLES (10-20%) POORLY SORTED, SUB- ANGULAR, WET AT 14'		WELL 2" PVC 5 1/2' SUMP SCREEN FROM 13 1/2' - 18 1/2' 2 1/2' STICKUP 1 1/2' CUT OFF 28' STRING STEAM CLEANING 45 MIN. PUMPED 30 GALLONS UNTIL CLEAR DURING DEVELOPMENT
17				1 1/2'				
18								
19			25		($< 8 / -$)	CLAY, GRAY/GREEN, SOFT, DAMP, SLIGHTLY PLASTIC		
20			26		($< 8 / -$)			
21				5'				
22						CLAY, "SHALE LIKE" DRYER THAN ABOVE		
23			27					
24			T.D.					



PROJECT NUMBER MG 21279 AO	BORING NUMBER 11 (NO WELL)	SHEET 1 OF 1
SOIL BORING LOG		

PROJECT GENERAL BATTERY LOCATION SELMA, AL
ELEVATION _____ DRILLING CONTRACTOR TTL, TUSCALOOSA, AL
DRILLING METHOD AND EQUIPMENT CME 55, HOLLOW-STEM AUGER
WATER LEVEL AND DATE _____ START 7-15-86 FINISH 7-15-86 LOGGER M.T. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			LEAD (PPM) (TOTAL / EP)	SOIL DESCRIPTION <small>NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL</small>	SYMBOLIC LOG	COMMENTS <small>DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION</small>
		INTERVAL	TYPE AND NUMBER	RECOVERY				
			7			<u>SAND, DARK BROWN, VERY FINE</u>		<u>DRY HOLE, GROUTED TO LAND SURFACE</u> <u>MOVED TO 11A UP HILL</u>
1			8			<u>SAND, MEDIUM BROWN TO LIGHT GRAY AT 1', LIGHTER BROWN WITH MINOR PEBBLES AT BASE, DRY, SOFT</u>		
2				2 1/2'				
3								
4						<u>CLAY, GREEN/GRAY/RUST MOTTLED, DENSE, DRY, SLIGHTLY PLASTIC</u>		
5			9					
6			10	4'		<u>CLAY, GRAY/GREEN, "SHALE LIKE" STIFF</u>		
7			11			<u>CLAY, SOFTER BUT AS ABOVE</u>		
8			12			<u>CLAY, VERY STIFF, GRAY GREEN, UNIFORM COLOR & GRAIN SIZE</u>		
9				T.D.				



PROJECT NUMBER MG 21279 A0	BORING NUMBER 11A	SHEET 1 OF 1
SOIL BORING LOG		

PROJECT GENERAL BATTERY LOCATION SELMA, AL
ELEVATION _____ DRILLING CONTRACTOR TTL, TUSCALOOSA, AL
DRILLING METHOD AND EQUIPMENT CME 55, HOLLOW-STEM AUGER
WATER LEVEL AND DATE _____ START 7-15-86 FINISH 7-15-86 LOGGER MT. REILLY

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			LEAD (PPM) (TOTAL/ EP)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		INTERVAL	TYPE AND NUMBER	RECOVERY				
	1		13		(944/-008)	SAND, BROWN, DISTURBED BY DOZER, FILL, DRY		WELL 2" PVC CASING & SCREEN TO 14' b.i.s.
	2		14	3'		SAND, LIGHT GRAY, FINE TO MEDIUM GRAINED, DRY, SOFT		SCREEN SET FROM 8 1/2' - 13 1/2'
	3							STICKUP 2 1/2' CUT OFF 1 1/2'
	4							18' STRING
	5		15		(27/-)	SAND, TAN, UNIFORM, FINE TO MEDIUM GRAINED		STEAM CLEANING 1/2 HR.
	6			4'				PUMPED ~ 1 GALLON OF WATER TO DEVELOP
	7		16		(23/-)	SAND, DARK BROWN TO BLACK, LIGNITIC, PEBBLES (<5%), VERY FINE TO MEDIUM GRAINED		
	8							
	9							
	10		17		(<8/-)	SAND, LIGHT BROWN, WET AT ~ 11' FOR ONLY 1' ABOVE CLAY, PEBBLE LENSE ABOVE CLAY		
	11			4'				
	12							
	13		18		(<8/-)	CLAY, DARK GRAY/GREEN, STIFF, DRY, "SHALE LIKE" SHELL FRAGMENTS OCCASIONAL		
	14							

APPENDIX C
ANALYTICAL QUALITY CONTROL RESULTS
AND SAMPLE RESULTS

QUALITY ASSURANCE/
QUALITY CONTROL SUMMARY
GENERAL BATTERY
SOILS

<u>Description</u>	<u>Blanks</u>	<u>Accuracy (Mean % Recovery)</u>	<u>Accuracy- Matrix Spike (Mean % Recovery)</u>	<u>Precision (Mean RPD)</u>
SAMPLE NO. 7739				
Total Lead	<0.08	93	99	4
EP Toxicity Lead	<0.08	96	95	7
Soil pH in Water	--	102	--	0
SAMPLE NO. 7746				
Total Lead	<0.08	93	97	12
EP Toxicity Lead	<0.08	98	99	1
Soil pH in Water	--	102	--	1.7
SAMPLE NO. 7761				
Total Lead	<0.08	101	95	18
EP Toxicity Lead	<0.08	99	90	0
Soil pH in Water	--	99	--	2.7
SAMPLE NO. 7768				
Total Lead	<0.08	95	100	9
EP Toxicity Lead	<0.08	99	108	0
Soil pH in Water	--	99	--	1.8
SAMPLE NO. 7779				
Total Lead	<0.08	100	100	2
EP Toxicity Lead	<0.08	98	101	0
Soil pH in Water	--	99	--	0.7
SAMPLE NO. 7892				
Total Lead	<0.08	95	99	0
EP Toxicity Lead	<0.08	95	99	0

QUALITY ASSURANCE/
QUALITY CONTROL SUMMARY
GENERAL BATTERY
GROUNDWATER

	<u>Accuracy (Mean % Recovery)</u>	<u>Accuracy- Matrix Spike (Mean % Recovery)</u>	<u>Precision (Mean RPD)</u>
Arsenic	98	99	8
Cadmium	89	104	0
Chromium	96	99	0
Lead	97	96	8
Total Suspended Solids	91	--	5.3
Total Dissolved Solids	107	--	10
Sulfate	100	--	9



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7739

Description of Sample: Samples received in laboratory June 25, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *by bx*



General Battery
Laboratory No. 7739

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-13-A, Soil, 0"-3" Depth, 1559, 6/24/86, GG	5.8	481	0.97
GB-S-13-B, Soil, 3"-6" Depth, 1602, 6/24/86, GG	5.60	22	<0.08
GB-S-14-A, Soil, 0"-3" Depth, 1606, 6/24/86, GG	5.8	11,212	15
GB-S-14-B, Soil, 3"-6" Depth, 1609, 6/24/86, GG	6.0	129	<0.08
GB-S-15-A, Soil, 0"-3" Depth, 1612, 6/24/86, GG	5.3	3,412	8.2
GB-S-15-B, Soil, 3"-6" Depth, 1615, 6/24/86, GG	5.0	30	<0.08
GB-S-16-A, Soil, 0"-3" Depth, 1756, 6/24/86, GG	6.0	1,162	4.6
GB-S-16-B, Soil, 3"-6" Depth, 1800, 6/24/86, GG	5.6	132	<0.08
GB-S-17-A, Soil, 0"-3" Depth, 1750, 6/24/86, GG	6.2	374	0.76
GB-S-17-B, Soil, 3"-6" Depth, 1751, 6/24/86, GG	H	H	H
GB-S-18-A, Soil, 0"-3" Depth, 1746, 6/24/86, GG	5.4	578	5.5
GB-S-18-B, Soil, 3"-6" Depth, 1746, 6/24/86, GG	5.2	153	<0.08
GB-S-19-A, Soil, 0"-3" Depth, 1622, 6/24/86, GG	6.0	3,350	0.22
GB-S-19-B, Soil, 3"-6" Depth, 1622, 6/24/86, GG	6.3	653	0.19
GB-S-20-A, Soil, 0"-3" Depth, 1628, 6/24/86, GG	6.5	1,699	<0.08
GB-S-20-B, Soil, 3"-6" Depth, 1629, 6/24/86, GG	6.2	193	<0.08
GB-S-21-A, Soil, 0"-3" Depth, 1631, 6/24/86, GG	7.1	3,054	0.23
GB-S-21-B, Soil, 3"-6" Depth, 1631, 6/24/86, GG	7.4	2,104	0.17
GB-S-22-A, Soil, 0"-3" Depth, 1636, 6/24/86, GG	6.8	573	0.43

(Continued)

11/2000 2/2



General Battery
Laboratory No. 7739
(Continued)

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-22-B, Soil, 3"-6" Depth, 1638, 6/24/86, GG	6.2	258	<0.08
GB-S-23-A, Soil, 0"-3" Depth, 1640, 6/24/86, GG	7.0	432	0.19
GB-S-23-B, Soil, 3"-6" Depth, 1640, 6/24/86, GG	H	H	H
GB-S-24-A, Soil, 0"-3" Depth, 1445, 6/24/86, GG	6.1	93	0.15
GB-S-24-B, Soil, 3"-6" Depth, 1448, 6/24/86, GG	H	H	H
GB-S-25-A, Soil, 0"-3" Depth, 1725, 6/24/86, GG	6.5	328	0.65
GB-S-25-B, Soil, 3"-6" Depth, 1728, 6/24/86, GG	H	H	H
GB-S-26-A, Soil, 0"-3" Depth, 1733, 6/24/86, GG	7.6	1870	5.0
GB-S-26-B, Soil, 3"-6" Depth, 1735, 6/24/86, GG	7.0	215	0.34
GB-S-27-A, Soil, 0"-3" Depth, 1740, 6/24/86, GG	7.1	706	0.15
GB-S-27-B, Soil, 3"-6" Depth, 1741, 6/24/86, GG	6.2	230	<0.08
GB-S-28-A, Soil, 0"-3" Depth, 1528, 6/24/86, GG	6.5	329	0.13
GB-S-28-B, Soil, 3"-6" Depth, 1530, 6/24/86, GG	H	H	H
GB-S-29-A, Soil, 0"-3" Depth, 1520, 6/24/86, GG	6.3	359	0.19
GB-S-29-B, Soil, 3"-6" Depth, 1525, 6/24/86, GG	H	H	H
GB-S-30-A, Soil, 0"-3" Depth, 1512, 6/24/86, GG	6.0	364	0.27
GB-S-30-B, Soil, 3"-6" Depth, 1516, 6/24/86, GG	H	H	H
GB-S-31-A, Soil, 0"-3" Depth, 1506, 6/24/86, GG	7.2	174	0.12

(Continued)



General Battery
Laboratory No. 7739
(Continued)

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-31-B, Soil, 3"-6" Depth, 1510, 6/24/86, GG	H	H	H
GB-S-32-A, Soil, 0"-3" Depth, 1500, 6/24/86, GG	7.8	370	0.76
GB-S-32-B, Soil, 3"-6" Depth, 1504, 6/24/86, GG	H	H	H

H--Analysis of sample placed on "hold."

NOTE: pH analyzed as Soil pH in water.

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson R. CK
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7746

Description of Sample: Samples received in laboratory June 26, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *dy CR*



General Battery
Laboratory No. 7746

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-1-A, Soil, 0"-3" Depth, 1047, 6/25/86, GG	6.0	182	4.0
GB-S-1-B, Soil, 3"-6" Depth, 1048, 6/25/86, GG	H	H	H
GB-S-2-A, Soil, 0"-3" Depth, 1053, 6/25/86, GG	6.8	9,822	68.8
GB-S-2-B, Soil, 3"-6" Depth, 1055, 6/25/86, GG	6.7	1,702	0.21
GB-S-3-A, Soil, 0"-3" Depth, 1059, 6/25/86, GG	7.2	24,344	23.4
GB-S-3-B, Soil, 3"-6" Depth, 1059, 6/25/86, GG	6.8	2,858	4.20
GB-S-4-A, Soil, 0"-3" Depth, 1106, 6/25/86, GG	7.4	5,922	13.0
GB-S-4-B, Soil, 3"-6" Depth, 1108, 6/25/86, GG	6.3	26,040	3.70
GB-S-5-A, Soil, 0"-3" Depth, 1127, 6/25/86, GG	7.4	13,064	315
GB-S-5-B, Soil, 3"-6" Depth, 1127, 6/25/86, GG	6.7	27,895	0.24
GB-S-6-A, Soil, 0"-3" Depth, 1132, 6/25/86, GG	8.1	1,398	7.7
GB-S-6-B, Soil, 3"-6" Depth, 1132, 6/25/86, GG	7.8	2,074	6.2
GB-S-7-A, Soil, 0"-3" Depth, 1030, 6/25/86, GG	7.1	83,100	734
GB-S-7-B, Soil, 3"-6" Depth, 1030, 6/25/86, GG	6.6	91,140	0.84
GB-S-8-A, Soil, 0"-3" Depth, 1025, 6/25/86, GG	7.6	59,660	698
GB-S-8-B, Soil, 3"-6" Depth, 1025, 6/25/86, GG	6.2	1,681	39
GB-S-9-A, Soil, 0"-3" Depth, 1036, 6/25/86, GG	8.1	1,901	175
GB-S-9-B, Soil, 3"-6" Depth, 1038, 6/25/86, GG	5.7	96	0.20

(Continued)



General Battery
Laboratory No. 7746
(Continued)

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-10-A, Soil, 0"-3" Depth, 1016, 6/25/86, GG	7.9	1,214	3.8
GB-S-10-B, Soil, 3"-6" Depth, 1018, 6/25/86, GG	6.9	50	<0.08
GB-S-11-A, Soil, 0"-3" Depth, 1020, 6/25/86, GG	7.9	20,980	586
GB-S-11-B, Soil, 3"-6" Depth, 1022, 6/25/86, GG	7.9	5,294	27
GB-S-12-A, Soil, 0"-3" Depth, 1010, 6/25/86, GG	8.2	1,469	2.6
GB-S-12-B, Soil, 3"-6" Depth, 1015, 6/25/86, GG	7.6	153	0.12
GB-S-33-A, Soil, 0"-3" Depth, 1300, 6/25/86, GG	6.4	885	0.28
GB-S-33-B, Soil, 3"-6" Depth, 1302, 6/25/86, GG	6.1	878	<0.08
GB-S-34-A, Soil, 0"-3" Depth, 1315, 6/25/86, GG	5.9	194	3.1
GB-S-34-B, Soil, 3"-6" Depth, 1318, 6/25/86, GG	H	H	H
GB-S-35-A, Soil, 0"-3" Depth, 1323, 6/25/86, GG	4.7	116	<0.08
GB-S-35-B, Soil, 3"-6" Depth, 1325, 6/25/86, GG	H	H	H
GB-S-36-A, Soil, 0"-3" Depth, 1352, 6/25/86, GG	5.6	139	<0.08
GB-S-36-B, Soil, 3"-6" Depth, 1355, 6/25/86, GG	H	H	H
GB-S-37-A, Soil, 0"-3" Depth, 1400, 6/25/86, GG	5.0	128	<0.08
GB-S-37-B, Soil, 3"-6" Depth, 1402, 6/25/86, GG	H	H	H
GB-S-38-A, Soil, 0"-3" Depth, 1415, 6/25/86, GG	7.8	294	0.59
GB-S-38-B, Soil, 3"-6" Depth, 1417, 6/25/86, GG	H	H	H

(Continued)



General Battery
Laboratory No. 7746
(Continued)

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-39-A, Soil, 0"-3" Depth, 1426, 6/25/86, GG	5.7	26	0.11
GB-S-39-B, Soil, 3"-6" Depth, 1429, 6/25/86, GG	H	H	H
GB-S-40-A, Soil, 0"-3" Depth, 1435, 6/25/86, GG	5.7	28	0.92
GB-S-40-B, Soil, 3"-6" Depth, 1438, 6/25/86, GG	H	H	H
GB-S-41-A, Soil, 0"-3" Depth, 1455, 6/25/86, GG	5.8	76	<0.08
GB-S-41-B, Soil, 3"-6" Depth, 1500, 6/25/86, GG	H	H	H
GB-S-42-A, Soil, 0"-3" Depth, 1502, 6/25/86, GG	5.1	56	<0.08
GB-S-42-B, Soil, 3"-6" Depth, 1504, 6/25/86, GG	H	H	H
GB-S-43-A, Soil, 0"-3" Depth, 1525, 6/25/86, GG	5.2	44	<0.08
GB-S-43-B, Soil, 3"-6" Depth, 1530, 6/25/86, GG	H	H	H
GB-S-44-A, Soil, 0"-3" Depth, 1542, 6/25/86, GG	5.4	107	<0.08
GB-S-44-B, Soil, 3"-6" Depth, 1544, 6/25/86, GG	H	H	H
GB-S-45-A, Soil, 0"-3" Depth, 1551, 6/25/86, GG	6.6	16	<0.08
GB-S-45-B, Soil, 3"-6" Depth, 1555, 6/25/86, GG	H	H	H
GB-S-46-A, Soil, 0"-3" Depth, 1600, 6/25/86, GG	6.2	45	<0.08
GB-S-46-B, Soil, 3"-6" Depth, 1602, 6/25/86, GG	H	H	H
GB-S-47-A, Soil, 0"-3" Depth, 1620, 6/25/86, GG	7.5	66	<0.08
GB-S-47-B, Soil, 3"-6" Depth, 1622, 6/25/86, GG	H	H	H
GB-S-48-A, Soil, 0"-3" Depth, 1625, 6/25/86, GG	5.7	179	0.78

(Continued)



General Battery
Laboratory No. 7746
(Continued)

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-48-B, Soil, 3"-6" Depth, 1628, 6/25/86, GG	H	H	H
GB-S-49-A, Soil, 0"-3" Depth, 1630, 6/25/86, GG	6.0	60	<0.08
GB-S-49-B, Soil, 3"-6" Depth, 1635, 6/25/86, GG	H	H	H

H--Analysis of sample placed on "hold."

NOTE: pH analyzed as Soil pH in water.

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager



General Battery
Laboratory No. 7761

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-50-A, Soil, 0"-3" Depth, 0830, 6/27/86, GG, Grab	5.4	77	<0.08
GB-S-50-B, Soil, 3"-6" Depth, 0832, 6/27/86, GG, Grab	H	H	H
GB-S-51-A, Soil, 0"-3" Depth, 0845, 6/27/86, GG, Grab	6.5	132	<0.08
GB-S-51-B, Soil, 3"-6" Depth, 0847, 6/27/86, GG, Grab	H	H	H
GB-S-52-A, Soil, 0"-3" Depth, 0858, 6/27/86, GG, Grab	5.7	85	<0.08
GB-S-52-B, Soil, 3"-6" Depth, 0900, 6/27/86, GG, Grab	H	H	H
GB-S-67, Sediment, 1251, GG, Grab	5.4	19	<0.08
GB-S-68, Sediment, 1257, GG, Grab	5.3	57	<0.08
GB-S-69, Sediment, 1300, GG, Grab	5.2	169	<0.08
GB-S-70, Sediment, 1333, GG, Grab	5.4	13	<0.08
GB-S-71, Sediment, 1345, GG, Grab	8.2	20	<0.08
GB-S-72, Sediment, 1352, GG, Grab	7.9	17	<0.08
GB-S-73, Sediment, 1405, GG, Grab	7.8	61	<0.08
GB-S-74, Sediment, 1415, GG, Grab	8.3	<8	0.20
GB-S-75, Sediment, 1430, GG, Grab	8.2	14	0.08
GB-S-76, Sediment, 1440, GG, Grab	7.9	65	<0.08
GB-S-77, Sediment, 1500, GG, Grab	7.6	13	<0.08
GB-S-78, Sediment, 1517, GG, Grab	8.1	13	<0.08

H--Analysis of sample placed on "hold."

NOTE: pH analyzed as Soil pH in water.

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7761

Description of Sample: Samples received in laboratory June 30, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *67 DR*



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7768

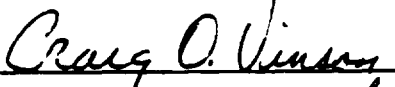
Description of Sample: Samples received in laboratory July 1, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,


Craig O. Vinson, Laboratory Director *by ER*



General Battery
Laboratory No. 7768

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-53-A, Soil, 0"-3" Depth, 1325, 6/30/86, GG	5.5	79	<0.08
GB-S-53-B, Soil, 3"-6" Depth, 1327, 6/30/86, GG	H	H	H
GB-S-54-A, Soil, 0"-3" Depth, 1343, 6/30/86, GG	5.5	310	<0.08
GB-S-54-B, Soil, 3"-6" Depth, 1343, 6/30/86, GG	H	H	H
GB-S-55-A, Soil, 0"-3" Depth, 1415, 6/30/86, GG	4.4	120	<0.08
GB-S-55-B, Soil, 3"-6" Depth, 1420, 6/30/86, GG	H	H	H
GB-S-56-A, Soil, 0"-3" Depth, 1432, 6/30/86, GG	6.6	71	<0.08
GB-S-56-B, Soil, 3"-6" Depth, 1435, 6/30/86, GG	H	H	H
GB-S-79, Sediment, 1500, 6/30/86, GG	8.3	21	0.31
GB-S-80, Sediment, 1503, 6/30/86, GG	8.3	34	0.72
GB-S-81, Sediment, 1508, 6/30/86, GG	5.0	80	--
GB-S-82, Sediment, 1520, 6/30/86, GG	5.1	16	--
GB-S-83, Sediment, 1523, 6/30/86, GG	4.5	85	--
GB-S-84, Sediment, 1530, 6/30/86, GG	5.3	148	--
GB-S-85, Sediment, 1538, 6/30/86, GG	5.6	57	--
GB-S-86, Sediment, 1545, 6/30/86, GG	5.6	27	--
GB-S-87, Sediment, 1550, 6/30/86, GG	5.2	78	--

H--Analysis of sample placed on "hold."

NOTE: pH analyzed as Soil pH in water.

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager *by OK*



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7779

Description of Sample: Samples received in laboratory July 2, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *o, de*



General Battery
Laboratory No. 7779

Description	pH (Units)	Total Lead mg/kg	EP Toxicity Lead mg/l
GB-S-57-A, Soil, 0"-3" Depth, 7/1/86, 1115, GG	5.0	169	--
GB-S-57-B, Soil, 3"-6" Depth, 7/1/86, 1115, GG	H	H	H
GB-S-58-A, Soil, 0"-3" Depth, 7/1/86, 1515, GG	6.8	322	<0.08
GB-S-58-B, Soil, 3"-6" Depth, 7/1/86, 1518, GG	H	H	H
GB-S-59-A, Soil, 0"-3" Depth, 7/1/86, 1535, GG	6.5	67	--
GB-S-59-B, Soil, 3"-6" Depth, 7/1/86, 1537, GG	H	H	H
GB-S-60-A, Soil, 0"-3" Depth, 7/1/86, 1550, GG	5.5	83	--
GB-S-60-B, Soil, 3"-6" Depth, 7/1/86, 1552, GG	H	H	H
GB-S-61-A, Soil, 0"-3" Depth, 7/1/86, 1610, GG	6.4	310	<0.08
GB-S-61-B, Soil, 3"-6" Depth, 7/1/86, 1612, GG	H	H	H
GB-S-62-A, Soil, 0"-3" Depth, 7/1/86, 1624, GG	6.3	701	0.12
GB-S-62-B, Soil, 3"-6" Depth, 7/1/86, 1628, GG	6.4	364	0.10
GB-S-63-A, Soil, 0"-3" Depth, 7/1/86, 1635, GG	5.6	628	<0.08
GB-S-63-B, Soil, 3"-6" Depth, 7/1/86, 1637, GG	5.2	508	0.15
GB-S-64-A, Soil, 0"-3" Depth, 7/1/86, 1640, GG	5.4	1,005	<0.08
GB-S-64-B, Soil, 3"-6" Depth, 7/1/86, 1642, GG	5.0	503	<0.08
GB-S-65-A, Soil, 0"-3" Depth, 7/1/86, 1656, GG	5.9	177	--
GB-S-65-B, Soil, 3"-6" Depth, 7/1/86, 1656, GG	H	H	H
GB-S-66-A, Soil, 0"-3" Depth, 7/1/86, 1702, GG	5.8	50	--
GB-S-66-B, Soil, 3"-6" Depth, 7/1/86, 1705, GG	H	H	H
GB-S-88, Sediment, 7/1/86, 1058, GG	7.7	<8	--
GB-S-88, Sediment, 7/1/86, 1110, GG	7.6	<8	--
GB-S-88, Sediment, 7/1/86, 1128, GG	8.0	<8	--
GB-S-88, Sediment, 7/1/86, 1140, GG	7.8	89	--
GB-S-88, Sediment, 7/1/86, 1153, GG	5.8	39	--
GB-S-88, Sediment, 7/1/86, 1210, GG	7.9	68	--
GB-S-88, Sediment, 7/1/86, 1220, GG	7.6	46	--
GB-S-88, Sediment, 7/1/86, 1233, GG	7.8	151	--
GB-S-88, Sediment, 7/1/86, 1245, GG	7.2	22	--

H--Analysis of sample placed on "hold."

NOTE: pH analyzed as Soil pH in water.

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig Vinson
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7881

Description of Sample: Samples received in laboratory July 24, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *C.O.V.*



General Battery
Laboratory No. 7881

Description	GB-W-1, GG Monitoring Well No. 8 7/24/86, 10:30	GB-W-2, GG Monitoring Well No. 9 7/24/86, 11:05	GB-W-3, GG Monitoring Well No. 10 7/24/86, 11:35	GB-W-4, GG Monitoring Well No. 4 7/24/86, 11:58
Total Suspended Solids	40	4374	6604	1215
Total Dissolved Solids	128	157	308	215
Sulfate	7.0	6.5	8.5	12.7
Lead	0.10	1.5	0.24	0.15
Lead-soluble	0.002	<0.002	0.004	<0.002
Cadmium	<0.001	0.001	0.002	<0.001
Cadmium-soluble	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.008	0.05	0.06	<0.008
Arsenic-soluble	<0.008	<0.008	<0.008	<0.008
Chromium	0.004	0.18	0.26	0.036
Chromium-soluble	0.003	<0.001	0.001	<0.001

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7892

Description of Sample: Samples received in laboratory July 28, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *by CK*



General Battery
Laboratory No. 7892

Description	Total Lead mg/kg	EP Toxicity Lead mg/L
GB-B-1-3-4 Monitor Well 8 at 3-4' Depth, 7/15/86, MTR	18.8	--
GB-B-2-9-11 Monitor Well 8 at 9-11' Depth, 7/15/86, MTR	<8	--
GB-B-5-14-16 Monitor Well 8 at 14-16' Depth, 7/15/86, MTR	<8	--
GB-B-6-16-16 1/2 Monitor Well 8 at 16-16 1/2' Depth, 7/15/86, MTR	<8	--
GB-B-13-1/2-1 Monitor Well 11A at 1/2-1' Depth, 7/15/86, MTR	944	<0.08
GB-B-15-4 1/2-5 Monitor Well 11A at 4 1/2-5' Depth, 7/15/86, MTR	27.1	--
GB-B-16-6 1/2-7 Monitor Well 11A at 6 1/2-7' Depth, 7/15/86, MTR	22.7	--
GB-B-17-9 1/2-10 Monitor Well 11A at 9 1/2-10' Depth, 7/15/86, MTR	<8	--
GB-B-18-12 1/2-13 Monitor Well 11A at 12 1/2-13' Depth, 7/15/86, MTR	<8	--
GB-B-19-1 1/2-2 Monitor Well 10 at 1 1/2-2' Depth, 7/16/86, MTR	199	--
GB-B-20-3 1/2-4 Monitor Well 10 at 3 1/2-4' Depth, 7/16/86, MTR	50.5	--
GB-B-23-9-9 1/2 Monitor Well 10 at 9-9 1/2' Depth, 7/16/86, MTR	<8	--
GB-B-25-18 1/2-19 Monitor Well 10 at 18 1/2-19' Depth, 7/16/86, MTR	<8	--
GB-B-26-20-20 1/2 Monitor Well 10 at 20-20 1/2' Depth, 7/16/86, MTR	<8	--
GB-B-28-1/2-1 Monitor Well 9 at 1/2-1 1/2' Depth, 7/16/86, MTR	58,600	0.20
GB-B-30-4 1/2-15 Monitor Well 9 at 4 1/2-5' Depth, 7/16/86, MTR	1,188	<0.08
GB-B-32-8-8 1/2 Monitor Well 9 at 8-8 1/2' Depth, 7/16/86, MTR	19.4	--

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7918

Description of Sample: Samples received in laboratory August 4, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *8/68*



General Battery
Laboratory No. 7918

Description	No. 1 1037 Grab GB-W-5 8/1/86	No. 10 1200 Grab GB-W-6 8/1/86	No. 11 1228 Grab GB-W-7 8/1/86	No. 8 1327 Grab GB-W-8 8/1/86	No. 5 1348 Grab GB-W-9 8/1/86	No. 9 1410 Grab GB-W-10 8/1/86
Total Dissolved Solids	96	350	306	160	92	182
Total Suspended Solids	4024	4998	336	129	293	6551
Sulfate	7.7	72.0	20.8	6.5	5.5	7.3
Lead	0.44	0.38	0.048	0.14	2.4	4.4
Lead - soluble	0.002	#	0.012	<0.002	0.061	0.020
Cadmium	0.003	0.005	0.002	<0.0008	<0.0008	0.005
Cadmium - soluble	<0.0008	#	<0.0008	<0.0008	<0.0008	<0.0008
Arsenic	0.11	0.011	0.017	0.005	0.006	0.13
Arsenic - soluble	<0.003	#	<0.003	<0.003	<0.003	<0.003
Chromium	0.15	0.24	0.063	0.043	0.068	0.42
Chromium - soluble	<0.002	#	<0.002	<0.002	<0.002	<0.002

*Sample insufficient for these parameters.
All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7943

Description of Sample: Samples received in laboratory August 8, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *B, RK*



General Battery
Laboratory No. 7943

Description	GB-W-11 Monitor Well No. 8	GB-W-12 Monitor Well No. 9	GB-W-13 Monitor Well No. 10	GB-W-14 Monitor Well No. 11
Total Dissolved Solids	157	202	314	351
Total Suspended Solids	215	3755	2145	469
Sulfate	8	10	72	18
Lead	0.005	1.1	0.15	0.023
Lead - soluble	<0.002	0.003	0.002	0.003
Cadmium	<0.0008	0.001	0.001	0.002
Cadmium - soluble	<0.0008	0.0009	0.001	<0.0008
Arsenic	0.006	0.09	0.06	0.013
Arsenic - soluble	<0.003	<0.003	<0.003	<0.003
Chromium	0.05	0.20	0.10	0.061
Chromium - soluble	<0.002	<0.002	<0.002	<0.002

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig C. Vinson, a.s.c.
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 7967

Description of Sample: Samples received in laboratory August 18, 1986.
Date Reported: September 3, 1986.

Please see attached report.

All results expressed as mg/L unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,

Craig O. Vinson
Craig O. Vinson, Laboratory Director *dy, dr*



General Battery
Laboratory No. 7967

Description	GBN-15 8/15/86	GB-W-16 8/15/86	GB-W-17 8/15/86	GB-W-18 8/15/86
Total Suspended Solids	971	8	2,109	5,895
Total Dissolved Solids	339	561	220	198
Sulfate	17	90	12	14
Lead	0.013	0.069	0.135	3.10
Lead-soluble	0.003	0.064	<0.002	<0.002
Cadmium	<0.005	0.001	<0.0005	0.001
Cadmium-soluble	<0.005	0.001	<0.0005	<0.0005
Arsenic	0.020	0.140	0.100	0.107
Arsenic-soluble	0.004	0.115	<0.003	<0.003
Chromium	0.016	0.418	0.213	0.292
Chromium-soluble	0.114	0.317	0.003	<0.002

All results expressed as mg/L unless otherwise noted.

Respectfully submitted,

Bill Rhodes
Bill Rhodes, Inorganic Laboratory Manager

Craig O. Vinson
Craig Vinson, Laboratory Manager



ENVIRONMENTAL LABORATORY
2567 Fairlane Drive
Montgomery, Alabama 36116
205/271-1444

REPORT OF ANALYSIS

Client General Battery Corporation Project No. MG21279.A0
Address P.O. 1262, Reading, PA 19603
Attention Mr. Jeffrey Leed Laboratory No. 8023

Description of Sample: Samples received in laboratory September 4, 1986.
Date Reported: October 16, 1986.

Description	9/4/86	9/4/86	9/4/86	9/4/86
	13:08	12:98	12:12	14:20
	Grab	Grab	Grab	Grab
	Monitor	Monitor	Monitor	Monitor
	Well 8	Well 9	Well 10	Well 11
	GB-W-19	GB-W-20	GB-W-21	GB-W-22
Total Suspended Solids	283	2414	1266	184
Total Dissolved Solids	143	170	282	331
Sulfate	3.0	3.4	22.9	8.6
Lead	0.013	1.7	0.069	0.012
Lead - soluble	<0.005	<0.005	<0.005	<0.005
Cadmium	0.002	0.008	0.003	0.004
Cadmium - soluble	0.001	0.006	0.002	0.001
Arsenic	0.01	0.07	0.07	0.03
Arsenic - soluble	<0.005	<0.005	<0.005	0.008
Chromium	0.05	0.16	0.11	0.05
Chromium - soluble	<0.001	<0.001	0.001	<0.001

All results expressed as mg/L, unless otherwise noted.

All analyses conducted in accordance with
STANDARD METHODS FOR WATER AND WASTEWATER.

Respectfully submitted,


Craig O. Vines, Laboratory Director *B, DE*

EMERY WORLDWIDE

February 13, 1987

Mr. Bernard E. Cox, Jr.
Chief, Hazardous Waste Branch
Land Division
Alabama Department of Environmental Management
1751 Federal Drive
Montgomery, AL 36130

RE: General Battery Corporation; Selma, Alabama
Inactive Site Investigation/Monitoring Plan

Dear Mr. Cox:

To confirm a telephone conversation on February 12, 1987 with Ms. Margaret Corey of your office, enclosed are two copies of the field investigation report prepared by CH2M-Hill for General Battery Corporation's facility in Selma, Alabama.

As indicated during the telephone conversation with Ms. Corey, General Battery Corporation would appreciate the opportunity to meet with appropriate members of your staff as soon as possible to discuss the contents of this document and future efforts.

Should additional information be required at this time, please contact this office at (215) 378-0852. GBC requests that your office advise with a suitable meeting date as soon as possible.

Thank you for your assistance in this matter.

Very truly yours,

GENERAL BATTERY CORPORATION

Jeffrey A. Leed /b

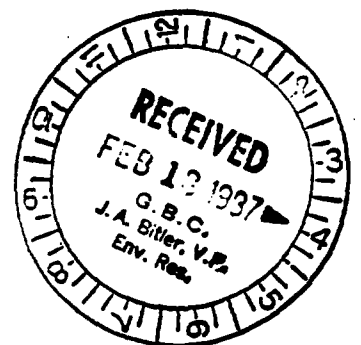
Jeffrey A. Leed
Manager, Wastes Disposal

JAL:sb

2/20

2/24/87

cc: J. B. Baker (Router B. Baker) - w/o attach.



NOT
Time
9:10 AM

ADEM

ALABAMA
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT



Guy Hunt
Governor

Leigh Pegues, Director

April 23, 1987

1751 Federal Drive
Montgomery, AL
36130
205/271-7700

Field Offices:

Unit 806, Building 8
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205/353-1713

2204 Perimeter Road
Mobile, AL
36615
205/479-2336

Mr. Jeffrey Leed
Manager, Wastes Disposal
Environmental Resources Department
General Battery Corporation
Post Office Box 1262
Reading, Pennsylvania 19603

General Battery Corporation
RECEIVED

APR 27 1987

Environmental Resources
Reading, Pa.

Dear Mr. Leed:

This letter will confirm the topics discussed in your April 1, 1987 meeting with Margaret Corey, W. B. Turk and Scott Qualls of this Department, J. A. Bitler of Battery Corporation, and Greg Goodman and Bob Goodson of CH2M-Hill. The meeting was held to review sampling data and discuss clean-up alternatives for the closed General Battery plant site in Selma, Alabama.

It is our understanding that General Battery will submit a clean-up proposal which will include the following:

- a. A schedule for resampling groundwater monitoring wells in order to verify earlier sampling data.
- b. A plan for soil removal in areas where the EP Toxicity Test shows lead levels in excess of 5 mg/l. All soils removed will be managed as hazardous waste and manifested for disposal at a permitted hazardous waste management facility. Areas where soil excavation occurs will be sampled and analyzed for EP toxicity and total lead, to ensure that all EP toxic soils are removed.
- c. A procedure for incorporating lesser contaminated soils, (where the EP toxicity for lead is less than 5 mg/l) with underlying soils through use of a roto-till. Areas where this process is implemented will be sampled and analyzed for EP toxicity and total lead, to verify the success of the process.
- d. A schedule for retesting areas where questionable results were obtained during earlier sampling events. Areas 14, 26, and 34 were mentioned in our meeting as areas where retesting may be appropriate.

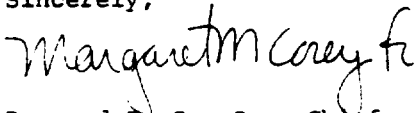
As Scott Qualls stated during the meeting, resampling of the groundwater monitoring wells must be accomplished to clarify results collected last summer, during a severe drought period. If groundwater analyses reveal that groundwater at the General Battery site has been contaminated, the company may be requested to begin a groundwater clean-up program under State Clean Water Act authorities.

Page 2
Mr. Jeffery Leed
April 23, 1987

We also discussed the fact that our Department, while supportive of General Battery's clean-up initiative, can only offer guidance as to the clean-up procedure. We will not be able to designate the site as "clean". Also, as you know the site has had some initial evaluation under CERCLA. General Battery's liability under CERCLA can not be eliminated, even though the company has voluntarily begun to clean up the Selma site. The test results discussed at our meeting indicated that highly contaminated areas are all located on General Battery property. We concur with General Battery's intention to mark the property deed in a manner that indicates the extent of site contamination and the steps taken to mitigate the problem.

We will await submittal of additional groundwater monitoring data and a site clean-up plan. Should questions arise, please contact Mr. W. B. Turk of the Hazardous Waste Branch at (205) 271-7737.

Sincerely,



Bernard E. Cox Jr., Chief
Hazardous Waste Branch
Land Division

BEC/MMC/sdm
cc: Mr. Scott Qualls
ADEM - Groundwater Section

Mr. Greg Goodman
CH2M-Hill

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

April 4, 1988

Ms. Margaret M. Corey
Chief, Compliance Section
Hazardous Waste Branch Land Division
Alabama Department of Environmental Management
1751 Federal Drive
Montgomery, AL 36130

RE: Exide/General Battery Corporation; Selma, Alabama

Dear Ms. Corey:

To confirm our telephone conversation on April 1, 1988, enclosed are two copies of the Closure Plan for Remediation of Lead Containing Soil at Exide/General Battery Corporation's facility in Selma, Alabama. Your expeditious review and approval of the Closure Plan is requested prior to implementation of on-site remedial work.

Should additional information be required, or should you wish to meet to discuss this plan, please contact this office at (215) 378-0852.

Very truly yours,

EXIDE/GENERAL BATTERY CORPORATION

Jeffrey A. Leed

Jeffrey A. Leed
Director - Waste Management

JAL:sb

Noted not read

4/5/88 JAL

RT 4/6/88

8/5/4/7

Leed

4/29

cc: J. Baranski/D. Ferrante/G. Hartman/W. Pallies/J. Bitler - w/attach.
R. Restrepo - w/o attach.
P. Ehlerman - w/o attach.
S. Gowney (ML&B) - w/attach.

ENVIRON

AP

RECEIVED
APR 11 1988
FBI - SELMA

EXIDE CORPORATION

**CLOSURE PLAN
FOR
REMEDICATION OF LEAD-CONTAINING SOIL**

Exide/General Battery Corporation

Old Montgomery Highway

Selma, Alabama

prepared by

Exide Corporation

Department of Environmental Resources

645 Penn Street

P. O. Box 14205

Reading, Pennsylvania 19612-4205

March 1988

645 Penn Street Reading, PA 19601
P.O. Box 14205 Reading, PA 19612-4205
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1.0 INTRODUCTION

1.1 BACKGROUND

General Battery Corporation and the Alabama Department of Environmental Management (ADEM), in a meeting held in Montgomery, Alabama on April 1, 1987, reviewed plans for remediation of lead-containing soil at the General Battery Corporation facility located along the Old Montgomery Highway in Selma, Alabama. A copy of correspondence from ADEM, confirming items discussed at the April 1, 1987 meeting, is provided in Appendix 1.

Exide Corporation acquired General Battery Corporation in May 1987. References in the document to Exide Corporation refer to the former General Battery Corporation facility in Selma, Alabama.

1.2 SCOPE

The information set forth in this document summarizes previous remedial work at the facility and describes the Exide Corporation plan for removal of lead-containing soil and completion of soil decontamination objectives at the Exide Corporation facility. Submission of the Closure Plan is made at the voluntary discretion by Exide Corporation for review and approval by the Alabama Department of Environmental Management.

1.3 OBJECTIVES

The objectives of this document are to:

- A. Review previous soil studies and remedial activities performed at the facility since cessation of battery manufacturing operations,
- B. Discuss plans for excavation and/or remediation of contaminated soil, for management of contaminated soil during on-site storage, and for off-site disposal of contaminated soil, and
- C. Discuss plans for assuring proper decontamination of soil.

2.0 DATA REVIEW

In February 1987, General Battery Corporation submitted two copies of the Field Investigation Report for the inactive Selma, Alabama plantsite (prepared by CH2M-Hill) to the Alabama Department of Environmental Management for review. The Field Investigation Report presented data from the analysis of 132 soil samples (66 collected at a depth of 0 (surface) to 3 inches below the surface, and 66 collected at a depth of 3 to 6 inches below the surface), 30 stream sediment samples, 32 soil boring samples, and 22 groundwater samples which were collected by CH2M-Hill during July-August 1986.

Data from the Field Investigation Report was reviewed during a meeting held in the ADEM offices in Montgomery, Alabama on April 1, 1987. Representatives at the meeting included the Alabama Department of Environmental Management, General Battery Corporation, and CH2M-Hill. Confirmation of items discussed at the meeting was provided in the April 23, 1987 correspondence from the ADEM, a copy of which is provided in Appendix 1.

To verify reported lead in soil concentrations and to address several inconsistencies in the data, CH2M-Hill was authorized by General Battery Corporation at the April 1, 1987 meeting to resample soil at sampling sites #14, #26, and #34. The scope of the additional work was subsequently revised to include resampling/reanalysis of soil at sites #15 and #18. The resampling/reanalysis program was later expanded by Exide Corporation to include confirmatory soil testing at four laboratories including CH2M-Hill (Montgomery, Alabama), Talbot Laboratories (Valley Forge, Pennsylvania), Lancaster Laboratories (Lancaster, Pennsylvania), and M.J. Reider Associates, Inc. (Reading, Pennsylvania).

Correspondence which described the resampling/reanalysis program was provided to the Alabama Department of Environmental Management on August 11, 1987. (A copy of this information is provided in Appendix 2). Pertinent information regarding the resampling/reanalysis program as related to the proposed soil remediation project at the plantsite is summarized as follows:

- A. The duplicate reanalysis of soil samples, using the EPA Extraction Procedure (EP) indicated lead concentrations below the EP toxicity limit of 5.0 mg/l for samples #15, #18, #26, and #34. Exide Corporation, as discussed in Sections 5.0 and 6.0, proposes to use the duplicate reanalysis data to define the remedial responses at these locations. These areas will be retested as part of the remedial work to ensure consistency with the site decontamination criteria outlined in Section 7.0.
- B. Duplicate reanalysis of the soil sample collected at site #14 showed one result above the EP toxicity limit of 5.0 mg/l and two results below this criterion. Since insufficient data remained following reanalysis of the soil at this location to perform additional verification testing, CH2M-Hill resampled this area. Discrete samples were collected by CH2M-Hill at approximately 10 feet east, south, and west of sample site #14 from a depth of 0-3

B. (Continued)

inches below the surface. (Another sample was taken 10 feet north of site #14 but was mislabeled and discarded). The 3 discrete samples were composited and analyzed by CH2M-Hill and Talbot Laboratories. Planned remedial activities at this location are discussed in Section 5.3.5.

- C. Subsequent review by CH2M-Hill of laboratory data presented in the Field Investigation Report indicated that the soil sample collected at site #8 had been overacidified during laboratory testing. This sample was subsequently retested by CH2M-Hill and Talbot Laboratories, however, the data from the retesting indicated that the remedial status of this location did not change from data presented in the Field Investigation Report. Remediation of this area is addressed as part of subsequent sections in this document.

For further evaluation of the CH2M-Hill data provided in the Field Investigation Report, split samples of CH2M-Hill's original soil samples (at sites #2, #3, #4, #5, #6, #9, #10, #12, and #16) were subsequently submitted to Talbot Laboratories for duplicate analysis. Results from Talbot Laboratories' testing is compared to CH2M-Hill data in Appendix 3.

Data from the CH2M-Hill Field Investigation Report are shown, by sampling location, on the aerial photograph reproductions of the facility which are attached to this document in Plot Plan Set A. Data sheets are provided for samples collected at a 0-3 inch depth, for samples collected at a 3-6 inch depth, and for samples collected from the streambeds. For sample sites which were resampled/retested, average concentrations from the resampling/retesting efforts are provided.

3.0 GROUNDWATER ASSESSMENT

As part of the Field Investigation Report conducted by CH2M-Hill for General Battery Corporation, four new monitoring wells were installed in 1986 to supplement the existing groundwater monitoring system at the facility. After the April 1, 1987 meeting with the Alabama Department of Environmental Management, CH2M-Hill was authorized to collect and analyze additional groundwater samples.

Continued discussions between ADEM, Exide Corporation, and CH2M-Hill regarding groundwater quality at the facility resulted in the issuance of correspondence (see Appendix 4) from ADEM on January 8, 1988. Exide Corporation has recently authorized CH2M-Hill to proceed with the quarterly collection of additional groundwater samples and with the first several tasks associated with the groundwater assessment. It is not the intention of this document to review groundwater assessment programs in further detail.

4.0 REVIEW OF PREVIOUS SOIL REMEDIATION EFFORTS

In August 1987, WHO Manufacturing (Selma, Alabama) initiated work at the Exide Corporation facility in Selma which included the sandblasting of outer walls and three concrete pads located along the west side of the building. In conjunction with this work, WHO Manufacturing was also authorized by Exide Corporation to excavate the soil immediately adjacent to the pads and to collect soil samples during and after the excavation.

Information related to the excavation and soil sampling which was performed in this area is provided in Appendix 5 and includes:

1. A reproduction of an aerial photograph which defines the limits of the excavation and the approximate locations at which soil samples were collected.
2. Reproductions of photographs which were taken during the excavation. (The photographs designate the approximate locations at which soil samples were collected for testing).
3. Laboratory data sheets from testing of soil samples by the Exide Corporation laboratory in Philadelphia, Pennsylvania. (Note that samples identified as #A - #G were collected during excavation of soil and represent soil which was ultimately removed during excavation. Data from samples #1 - #12 represent analyses of soil for samples which were collected after the initial excavation. Upon receipt of analyses following initial excavation, additional excavation was performed at sites #3 and #11. Following additional excavation, sites #3 and #11 were resampled. Data from the analysis of soil samples collected following additional excavation are provided on the M.J. Reider Associates, Inc. laboratory report which is also included in Appendix 5. The quality of soil remaining in the excavated area is, therefore, defined by samples #1 - #2, #4 - #10, and #12 on the Exide Corporation laboratory report and samples #3 and #11 on the M.J. Reider Associates laboratory report).

Upon attainment of acceptable lead in soil concentrations in this area, WHO Manufacturing was subsequently authorized to backfill the area with sand and stone. It is believed that the decontamination objectives of Section 7.0 have been met and that further remedial action is not required in this area.

A composite sample of excavated soil was subsequently collected and submitted for analysis by Industrial Resource Development Company (IRD), Norristown, Pennsylvania. Data from the IRD analysis of the composite sample was subsequently included with Exide Corporation's request for disposal authorization of this material at the Chemical Waste Management landfill in Emelle, Alabama. A copy of the disposal authorization request, as well as the purchase order issued to Chemical Waste Management for transportation and disposal of the material at the Emelle facility are provided in Appendix 6. Authorization for disposal of the material was received from Chemical Waste Management by telephone by WHO Manufacturing, acting on behalf of Exide Corporation, on March 11, 1988. A contract with Chemical Waste Management was signed by Exide Corporation on March 22, 1988 and removal of the material is expected from the plantsite prior to March 30, 1988.

5.0 PLAN FOR SOIL EXCAVATION AND BACKFILL

5.1 STREAMBEDS

Data from the analysis of 30 sediment samples from the streambed to the north of the Exide facility, collected by CH2M-Hill during the 1985 Inactive Site Investigation, indicated total lead concentrations for 30 analyses ranging from below detection limits (8 ppm Pb) to 169 ppm, with an average total lead concentration of 48 ppm. Concentrations of lead in streambed sediments, when tested using the Extraction Procedure (EP toxicity test), ranged from less than detection limits (0.08 mg/l) to 0.72 mg/l with an average concentration of less than 0.15 mg/l for 14 analyses.

Total lead concentrations and EP toxicity concentrations in the streambed soil are comparable to background soil lead concentrations found around the facility. E.P. toxicity concentrations are also well below 5.0 mg Pb/l, the concentration above which a waste is declared to be hazardous. Accordingly, no remediation of streambed soil is planned.

5.2 OFF SITE SOIL

5.2.1 GENERAL

In general, data from the analysis of soil samples collected in areas off-site from the Exide Corporation facility show low total lead levels and/or low EP toxicity levels such that remedial action in off-site areas is not required. Concentrations of total lead in 6 samples collected at the South Side Elementary School or from adjacent play areas averaged 58 mg Pb/kg.

5.2.2 SOIL SAMPLING SITE #34

The original sampling at site #34 by CH2M-Hill during the Field Investigation revealed a total lead concentration of 194 mg Pb/kg and an EP toxicity concentration of 3.10 mg Pb/l. The EP toxicity concentration, although less than the 5.0 mg Pb/l concentration above which a waste is declared hazardous, was inconsistent with EP toxicity concentrations from adjacent samples.

Subsequent reanalysis of the sample by CH2M-Hill, as well as three other laboratories (see data in Appendix 2) indicated total lead concentrations of 50-65 mg/kg and EP toxicity concentrations for lead ranging from less than 0.05 mg/l to 0.08 mg/l. Based upon reanalysis of the sample, remedial action is neither warranted nor planned at site #34.

5.2.3 SOIL SAMPLING SITES #19-#21

Data from the original sampling at sites #19-#21 during the CH2M-Hill Field Investigation indicated total lead concentrations ranging from 1699-3350 mg/kg in samples collected from a depth of 0-3 inches. Total lead levels from a depth of 3-6 inches were considerably lower. EP toxicity concentrations at all three sites and at both depths were insignificant. The presence of lead in these samples may be related to automobile/truck emissions and/or subsequent runoff from the roadway into the drainage trench.

Remedial action in this area, although not necessarily required, will be performed using soil conditioning techniques as discussed in Section 5.3.5.

An area approximately 10-20 feet wide extending along the roadway from immediately east of sample site #21 to immediately west of sample site #19, will be conditioned. After conditioning and if necessary to return the area to existing ground surface contours, soil from off-site locations will be placed onto the conditioned area and graded. Five soil samples from the conditioned area (one each at sites #19, #20, and #21; one to the east of site #21; and one to the west of #19) will be collected from a depth of 0-3 inches following conditioning for analysis for total lead. The conditioned area will subsequently be seeded and watered to ensure growth of vegetation.

5.3 ON-SITE SOIL

5.3.1 EXCAVATION OF ON-SITE SOIL

Upon authorization from the Alabama Department of Environmental Management, Exide Corporation will secure competitive bids and subsequently authorize its contractor to proceed with the excavation of lead-containing soil at on-site locations. Excavation will be performed in the on-site areas identified in Plot Plan Set B where E.P. toxicity concentrations for lead from previous samples collected during the CH2M-Hill Field Investigation work exceed 5.0 mg Pb/l. As indicated in Plot Plan Set B, the on-site area to be excavated includes the designated locations to the north and west of the Exide Corporation building.

Upon completion of the initial excavation, Exide Corporation or its authorized representative will collect soil samples from the excavated areas, in accordance with procedures specified in Section 8.0, to verify adequate decontamination. Samples will be analyzed for total lead and leachable lead using the E.P. toxicity test.

Following completion of laboratory analysis, the contractor will either be instructed to excavate additional soil (if adequate decontamination has not been accomplished) or to proceed with backfilling of clean soil.

If laboratory analyses of soil samples (collected after excavation of overlying soil) indicate E.P. toxicity concentrations of less than 5.0 mg Pb/l, no further soil excavation will be performed in the excavated areas. If E.P. toxicity concentrations are in the range of 3.0-5.0 mg Pb/l, the underlying soil will be conditioned as described in Section 5.3.5. Soil samples will be collected after conditioning is completed to verify adequate decontamination levels.

5.3.2 PLACEMENT OF BACKFILL INTO EXCAVATED AREAS

Upon attainment of adequate decontamination, as verified by soil sampling in excavated areas, the Exide contractor will be authorized to proceed with the placement of backfill. Soil used for backfill will be suitable to support the growth of indigenous vegetation. Backfilled areas, if any, which are subject to erosion will be backfilled on the surface with crushed stone of sufficient size to minimize future potential for erosion.

5.3.3 BACKFILL SOIL QUALITY

Prior to award of the contract, the Exide contractor will be required to specify (in writing to Exide Corporation) the location from which backfill soil will be obtained. Three representative samples of soil from this location will be supplied by the contractor to Exide Corporation prior to acceptance of this material for use. In the event that the source of soil changes during the project, the contractor will be required to advise Exide Corporation in writing and will provide three additional representative samples for testing.

The soil which will be used for backfill will meet, at a minimum, the metal concentrations which are discussed in Section 7.0 of the Closure Plan.

It is Exide Corporation's intention, during the course of this project, to collect samples of soil which are being used for backfill to verify that the quality of backfill soil does not change during completion of the project. Samples of backfill soil may be collected by representatives of the Alabama Department of Environmental Management for test purposes, or will be supplied by Exide Corporation or its authorized representative upon request.

5.3.4 SEEDING OF EXCAVATED AREAS

Following placement of backfill into excavated areas, the Exide contractor will be required to seed the backfilled areas to establish growth of indigenous vegetation. The contractor will be required to water the seed, as necessary, until vegetative growth is established.

5.3.5 SOIL CONDITIONING

The following locations at the plantsite will be subjected to the soil conditioning techniques outlined below:

- A. The area to the west and north (rear) of the Exide Corporation building, as shown on Plot Plan Set B. (This area will be conditioned only after excavation of overlying contaminated soils and only if E.P. toxicity concentrations of 3.0-5.0 mg Pb/l are obtained (as outlined in Section 5.3.1) from analysis of soil samples.
- B. The area, also shown on Plot Plan Set B, to the south (front) of the Exide Corporation building. (Sampling of soil by CH2M-Hill in this area during the Field Investigation revealed isolated areas of elevated lead levels in the soil at a depth of 0-3 inches. Samples from 3-6 inches below the surface in this area revealed low lead concentrations (e.g., total lead levels of about 100 ppm or less, and E.P. toxicity levels for lead of less than detection limits). Subsequent testing and reanalysis of surface soils in this area, as outlined in Appendix 2, indicated appreciably lower concentrations).

The following techniques (or combination of the following techniques) will be used for soil conditioning to "buffer" any isolated spot contamination that may exist in the designated areas.

- A. Using a rototiller or other comparable equipment, soils will be disked to a depth of approximately 12 inches below the surface. The effect of this action will be to disturb the existing soil to a depth of 12 inches, creating a mixing or blending effect of surface soils with underlying soils.
- B. Continued passes will be made with appropriate equipment through the disturbed soil to further blend the surface soils with underlying soil. The soil will subsequently be recontoured, adding soil (of acceptable quality) from off-site locations, if necessary, to meet the original grade or to attain the desired soil conditioning objectives. If soil from off-site locations is required to be added, the off-site soil will be blended with on-site soil as part of the final conditioning.

- C. After completion of the soil conditioning, soil samples will be collected from a depth of 0-3 inches below the ground surface, in accordance with procedures outlined in Section 8.0, to ensure adequate decontamination.
- D. Upon attainment of acceptable decontamination criteria as discussed in Section 7.0, the conditioned area will be seeded and watered to ensure growth of vegetation.

6.0 TEMPORARY SOIL STORAGE AND OFF-SITE DISPOSAL

6.1 ON-SITE SOIL MANAGEMENT AND TEMPORARY STORAGE

The Exide general contractor will be responsible for the excavation of contaminated soil, on-site transport of excavated materials to the temporary soil storage area, loading of authorized vehicles for transport to the off-site landfill, all work associated with soil conditioning, and reseeded of all excavated or conditioned areas.

Following excavation of contaminated soil and prior to off-site transport, the soil will either be loaded directly into trucks (or roll-off containers) or will be placed into an on-site area for temporary storage. The temporary soil storage area, if needed, will be constructed on a paved area at the facility. Since the storage area is paved, there will be no penetration of waste constituents to the subsurface environment during the temporary storage of excavated material. The soil stockpile will be covered during storage with a synthetic membrane (e.g., PVC sheet or equivalent) to minimize the resuspension of particulates into the atmosphere. A berm, constructed of clean soil from an authorized off-site location, will be constructed around the temporary soil stockpile to prevent runoff from the pile to adjacent areas. Upon removal of the soil from the stockpile area, the asphalt will be swept or otherwise cleaned for removal of the final volume of soil.

Although it is not expected to be necessary, should it become required to utilize another area for temporary storage of soil, the Alabama Department of Environmental Management will be notified prior to utilization of the alternate site. In the event that the alternate location is not located on an impervious surface, a synthetic membrane will be used as a liner for the pile and the pile will subsequently be covered. Should this situation occur, a dike would also be constructed with non-contaminated soil around the storage pile to prevent the migration of soil constituents into adjacent areas.

The Exide general contractor will load soil from the storage area into vehicles which will be used to transport the soil to the off-site landfill for disposal.

6.2 TRANSPORTATION AND OFF-SITE DISPOSAL OF SOIL

As discussed in Section 4.0, Exide Corporation has previously received authorization for disposal of contaminated soil at the Chemical Waste Management landfill in Emelle, Alabama. It is anticipated that all soil which is excavated during the implementation of the Closure Plan and which has been tested to meet the characteristics of a hazardous waste (or which is presumed to be hazardous on the basis of knowledge of waste constituents) will be disposed at the Chemical Waste Management Emelle facility. Disposal authorization from Chemical Waste Management will be obtained either as a new authorization or as an amendment to Exide Corporation's previous authorization. In the event

6.2 (Continued)

that another disposal facility is selected, the Alabama Department of Environmental Management will be advised by Exide Corporation prior to utilization.

All soil which meets the characteristics of a hazardous waste will be managed in accordance with the hazardous waste regulations of the Alabama Department of Environmental Management. Off-site transportation will be performed by an authorized hazardous waste transporter. Shipments of soil to the landfill will be accompanied with a Uniform Alabama Hazardous Waste Manifest.

7.0 DECONTAMINATION OBJECTIVES

Implementation of the Closure Plan as set forth in this document will be undertaken to achieve the following remedial objectives:

1. To excavate contaminated soil (which exceeds an E.P. toxicity concentration of 5.0 mg Pb/l),
2. For lesser contaminated soil (e.g., where E.P. toxicity concentrations are less than 5.0 mg Pb/l), to condition the soil with underlying soil, and
3. Upon completion of item 1 and 2 above, to sample and analyze the soil (for total lead and E.P. toxicity for lead) in the areas where remedial measures were implemented to verify the success of remedial efforts.

8.0 EVALUATION OF LEAD CONCENTRATIONS IN SURFACE SOILS

8.1 SAMPLING LOCATIONS

Following the excavation and removal of contaminated soil to the depth at which contaminants are not expected to be present in concentrations exceeding those specified in Section 7.0, a series of soil samples will be collected from the excavated and rototilled areas to ensure proper decontamination. While the samples are being collected from a specified area and are being analyzed in the laboratory, it is Exide Corporation's expectation that the contractor will be proceeding with remedial activities in adjacent areas. In this manner, soil excavation and collection of soil samples will proceed on an on-going basis until completion of the project.

Exide Corporation personnel or an authorized representative will collect soil samples in a grid network to verify adequate remediation. The grid network will be arranged such that soil samples are collected at a frequency of 1 sample per 50 feet in areas where surface soils were excavated and where rototilling was performed.

Sampling locations will be labeled and staked, or otherwise identified, until laboratory data are received to verify adequate decontamination. Approximate locations at which soil samples will be taken to verify adequate remediation are identified in Plot Plan Set B (attached). Where possible, the sampling location will correspond to the location at which testing was performed during the CH2M-Hill Field Investigation.

8.2 SOIL SAMPLING PROCEDURE

After soil sampling locations in the excavated area have been identified, a sample will be collected at each location using a stainless steel coring device, garden shovel, or equivalent to collect a soil core. For uniformity in sampling protocol, the core will measure approximately 2 inches in diameter and will be collected to a depth of about 3 inches below the surface. Additional cores will be collected at the sampling site, as necessary, to produce the required volume of soil for analytical testing.

Sampling equipment will be cleaned and, if necessary, washed with distilled water between samples in the field to prevent potential contamination of samples.

The designated representative of the Alabama Department of Environmental Management will be notified at least one week in advance of the initial excavation and sampling so that split samples may be obtained, if desired.

8.3 SAMPLE CONTAINERS

Samples will be packaged in new plastic sample bags or bottles, labeled, stored at room temperature, and forwarded to the laboratory for analysis. Sample containers will be marked to identify the sample location, number, and sample depth.

8.4 SOIL ANALYSIS PROCEDURES

Following collection and packaging, soil samples will be delivered to an EPA-certified laboratory for analysis. All samples for total lead analysis will be dried (samples for Extraction Procedure toxicity will be analyzed on an as-received basis) in the laboratory to constant weight at 105°C. After drying, the soil will be screened through a stainless steel 16-mesh sieve with the aid of a glass pestle. The unsieved portion (e.g., pebbles and vegetation) will be discarded. Soil will be analyzed for total lead using the nitric acid digestion procedure in "Test Methods for Evaluating Solid Wastes" (SW-846) or equivalent and for extractable lead using the EPA Extraction Procedure (40 CFR 261.24).

All lead analyses will be performed using atomic absorption spectrophotometric methods.

All soil samples which are collected from on-site locations during implementation of the remedial work will be analyzed for total lead and leachable lead using the E.P. toxicity test. Soil samples which are collected from the off-site locations (e.g., in the vicinity of sample sites #19-#21) where rototilling will be performed will be tested only for total lead. (Initial testing at sites #19-#21 revealed low or nondetectable lead concentrations using the E.P. toxicity test).

8.5 CHAIN OF CUSTODY CONTROL

The person who physically collects the soil samples will be responsible for completion of a Chain of Custody Record, an example of which is shown in Appendix 7. The Chain of Custody record will accompany the samples until receipt at the laboratory when it will be signed by the authorized laboratory representative and returned to Exide Corporation.

8.6 QUALITY CONTROL

The analytical laboratory will be required to document its internal quality control procedures and the results of routine daily quality control checks made while the samples from this study are being analyzed.

8.7 DATA CONFIRMATION WITH ADEM

If split samples were collected in a given area by the Alabama Department of Environmental Management, Exide will confirm laboratory data with ADEM prior to backfilling or proceeding further with remedial efforts. If split samples were not collected by ADEM, Exide's general contractor will be instructed to proceed with the backfill of excavated areas when the results of soil testing confirm satisfactory decontamination in accordance with Section 7.0.

In the event that analytical results indicate that decontamination objectives have not been achieved, additional excavation will be performed and additional samples will be collected until the decontamination objectives specified in Section 7.0 are achieved.

9.0 AMENDMENTS TO CLOSURE PLAN

If, during the completion of the activities associated with the Closure Plan, Exide Corporation determines that it is necessary to amend the Closure Plan, a written request will be submitted to the Alabama DEM for consideration. Exide Corporation will implement any amendments to the Closure Plan only following written acceptance from ADEM.

Exide Corporation requests that ADEM identify staff personnel that will serve as contact personnel during the completion of remedial activities.

10.0 DEED RECORDATION AND FINAL REPORT

Upon completion of Closure Plan implementation, it is Exide Corporation's intention to mark the property deed in a manner that indicates the extent of site contamination and efforts that were taken to mitigate the problem. The deed recordation is expected to include a notation which encourages future site owners to maintain vegetative cover on soil at the site and to minimize activities which involve disturbance of asphalt roadways or the existing soil cover.

A final report, concisely summarizing the implementation of remedial activities and data from soil testing, will be submitted by Exide Corporation to the Alabama Department of Environmental Management upon completion of remedial activities.

11.0 SCHEDULE FOR PLAN IMPLEMENTATION

Upon written approval of the Exide Corporation Closure Plan by the Alabama Department of Environmental Management, Exide will secure quotations from prospective vendors for completion of soil remediation activities. Notice will be provided to ADEM at least one week in advance of the initial excavation and sampling so that split samples may be obtained by ADEM, if desired.

Although the total length of time required for project completion is not known due to the uncertainties in time requirements for sampling and verification of decontamination, it is Exide Corporation's intention to proceed on a continuing basis with this project until all areas have been successfully decontaminated.

APPENDIX 1

ADEM CORRESPONDENCE - 4/23/87

(CONFIRMATION OF ITEMS REVIEWED AT 4/1/87 MEETING)

ADEM

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT



Guy Hunt
Governor

Leigh Pegues, Director

April 23, 1987

51 Federal Drive
Montgomery, AL
36130
205/271-7700

General Battery Corporation
RECEIVED

APR 27 1987

Environmental Resources
Reading, Pa.

Field Offices:

104 Building 8
15 Osborn Circle
Birmingham, AL
35209
205/942-6188

Mr. Jeffrey Leed
Manager, Wastes Disposal
Environmental Resources Department
General Battery Corporation
Post Office Box 1262
Reading, Pennsylvania 19603

Dear Mr. Leed:

P.O. Box 953
Montgomery, AL
36102
205/353-1713

This letter will confirm the topics discussed in your April 1, 1987 meeting with Margaret Corey, W. B. Turk and Scott Qualls of this Department, J. A. Bitler of Battery Corporation, and Greg Goodman and Bob Goodson of CH2M-Hill. The meeting was held to review sampling data and discuss clean-up alternatives for the closed General Battery plant site in Selma, Alabama.

104 Perimeter Road
Mobile, AL
36615
205/478-2336

It is our understanding that General Battery will submit a clean-up proposal which will include the following:

- a. A schedule for resampling groundwater monitoring wells in order to verify earlier sampling data.
- b. A plan for soil removal in areas where the EP Toxicity Test shows lead levels in excess of 5 mg/l. All soils removed will be managed as hazardous waste and manifested for disposal at a permitted hazardous waste management facility. Areas where soil excavation occurs will be sampled and analyzed for EP toxicity and total lead, to ensure that all EP toxic soils are removed.
- c. A procedure for incorporating lesser contaminated soils, (where the EP toxicity for lead is less than 5 mg/l) with underlying soils through use of a roto-till. Areas where this process is implemented will be sampled and analyzed for EP toxicity and total lead, to verify the success of the process.
- d. A schedule for retesting areas where questionable results were obtained during earlier sampling events. Areas 14, 26, and 34 were mentioned in our meeting as areas where retesting may be appropriate.

As Scott Qualls stated during the meeting, resampling of the groundwater monitoring wells must be accomplished to clarify results collected last summer, during a severe drought period. If groundwater analyses reveal that groundwater at the General Battery site has been contaminated, the company may be requested to begin a groundwater clean-up program under State Clean Water Act authorities.

Page 2

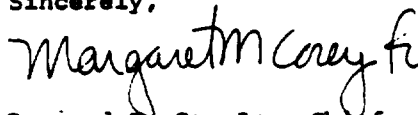
Mr. Jeffery Leed

April 23, 1987

We also discussed the fact that our Department, while supportive of General Battery's clean-up initiative, can only offer guidance as to the clean-up procedure. We will not be able to designate the site as "clean". Also, as you know the site has had some initial evaluation under CERCLA. General Battery's liability under CERCLA can not be eliminated, even though the company has voluntarily begun to clean up the Selma site. The test results discussed at our meeting indicated that highly contaminated areas are all located on General Battery property. We concur with General Battery's intention to mark the property deed in a manner that indicates the extent of site contamination and the steps taken to mitigate the problem.

We will await submittal of additional groundwater monitoring data and a site clean-up plan. Should questions arise, please contact Mr. W. B. Turk of the Hazardous Waste Branch at (205) 271-7737.

Sincerely,



Bernard E. Cox Jr., Chief
Hazardous Waste Branch
Land Division

BEC/MMC/sdm

cc: Mr. Scott Qualls
ADEM - Groundwater Section

Mr. Greg Goodman
CH2M-Hill

APPENDIX 2

CH2M-HILL CORRESPONDENCE - 8/11/87

(RESULTS OF SOIL RESAMPLING/REANALYSIS PROGRAM)



August 11, 1987

MG21279.AO.05

Mr. David Hagan
Alabama Department of Environmental
Management
1751 Federal Drive
Montgomery, Alabama 36130

Dear Mr. Hagan:

Subject: General Battery - Selma: Retesting Results for
Soil Samples 14, 15, 26, 34

Table 1, attached, presents the analytical results presented in the Field Investigation report, along with the results of duplicate reanalyses for the five samples listed above. All these analyses were performed on the samples collected in 1986.

The duplicate reanalysis shows EP lead levels below the toxicity limit of 5.0 mg/l for samples 15, 18, 26, and 34. Duplicate reanalysis of sample 14 showed one EP result above and two below the toxicity limit.

Exide/General Battery Corporation proposes to use the duplicate reanalysis data to define our responses to the areas surrounding samples 15, 18, 26, and 34. These areas will be tested after we respond to them to show that they meet cleanup criteria agreed to by ADEM and Exide/General Battery Corporation.

After reanalysis of sample 14, insufficient sample remained to determine the toxicity status of this area. Therefore, the area around sample point 14 was resampled by CH2M HILL to determine the toxicity status and extent of contamination. Discrete samples were taken approximately 10 feet east, south, and west of sample point 14 from the 0-3 inches depth. Another sample was taken 10 feet north but was mislabeled and discarded.

The three discrete samples were composited. Table 2, attached, presents the analytical results of the composite sample collected near sample point 14.

Ms. Margaret Corey
Page 2
July 23, 1987
MG21279.AO.05

Results presented in Tables 1 and 2 suggest contamination in the vicinity of sample point 14 is not widespread. Since this area was never used for plant operations, this would be expected. Table 1 shows a large variability in EP Toxicity laboratory results.

Due to laboratory variability, small area involved, and former land use, Exide/General Battery Corporation proposes to rototill an area of approximately 20'x20' centered around sample point 14. This approach will result in a "buffering" of any spot contamination that may exist in that area. After tilling, the area will be tested to show that it meets the cleanup criteria agreed to by ADEM and Exide/General Battery Corporation.

Because of the difference found between samples and laboratories during the reanalysis discussed above, the laboratory data presented in the Field Investigation Report was reviewed by CH2M HILL for laboratory errors. This review found that sample GB-S-8B had been over-acidified during the extraction process. This sample was reanalyzed in duplicate to determine its total and EP lead value. These values are presented in Table 2. The status of this sample has not changed from that presented in the Field Investigation Report.

Please contact me at 271-1444 if you have any questions or comments concerning this letter. It is the intention of Exide/General Battery Corporation to submit a remedial action plan to your office in the near future. Remediation of surface soil at the plantsite will begin after ADEM approval of the remedial action plan.

Sincerely,



Greg Goodman
Project Manager

mgGG3/026

Enclosure

cc: J. Leed - Exide/General Battery
Corporation (w/attachment)

TABLE 1
GBC SELMA
INTERLABORATORY SOIL ANALYSIS - SAMPLE SET 1

	<u>Sample Set 1</u>		<u>Sample Set 1 (repeat analysis)</u>		
	<u>CH2M-HILL</u>	<u>CH2M-HILL</u>	<u>TALBOT-LABS</u>	<u>LANCASTER LABS</u>	<u>M.J. REIDER ASSOC. INC.</u>
<u>Analysis Date</u>	(Montgomery, AL)	(Montgomery, AL)	(Valley Forge, PA)	(Lancaster, PA)	(Reading, PA)
	7/86	4/87	4/87	5/87	6/87
<u>Site 14</u>					
Total Lead	11,212	10,500	5,361.1	14,500	1,630
EP Toxicity - Lead	15.00	9.8	1.20	*	0.273
<u>Site 15</u>					
Total Lead	3,412	2,500	3,165.3	2,550	2,860
EP Toxicity - Lead	8.20	1.8	0.252	*	0.818
<u>Site 18</u>					
Total Lead	578	850	649.3	879	2,100
EP Toxicity - Lead	5.50	1.2	0.15	0.14	0.364
<u>Site 26</u>					
Total Lead	1,870	920	2,308.9	3,580	790
EP Toxicity - Lead	5.0	2.1	0.52	0.72	0.091
<u>Site 34</u>					
Total Lead	194	60	62.46	65	50
EP Toxicity - Lead	3.10	0.08	0.06	LT 0.05	*

Total Lead in mg/kg (ppm)

EP Lead in mg/l (ppm)

* = Insufficient Sample to Perform EP Toxicity Leachate.

Data taken from Exide/General Battery Corporation correspondence.

TABLE 2
GBC SELMA
INTERLABORATORY SOIL ANALYSIS - SAMPLE SET 2

	<u>Sample Set 1</u>	<u>Sample Set 1 (repeat analysis)</u>
	<u>CH2M-HILL</u>	<u>TALBOT LABORATORIES</u>
	(Montgomery, AL)	(Valley Forge, PA)
<u>Analysis Date</u>	6/87	6/87
<u>Site 8B</u>		
Total Lead	3,500	932.38
EP Toxicity - Lead	25	15.62
 <u>Site 14 Composite</u>		
Total Lead	7,600	5,376.74
EP Toxicity - Lead	0.041	0.69
 Total Lead in mg/kg (ppm)		
EP lead in mg/l (ppm)		

Data taken from Exide/General Battery Corporation correspondence.

APPENDIX 3

INTERLABORATORY SOIL ANALYSIS - SAMPLE SET 3

GBC SELMA

INTERLABORATORY SOIL ANALYSIS - SAMPLE SET 3

	<u>Sample Set 3</u>	<u>Sample Set 3 (Repeat analysis)</u>
	CH2M-Hill	Talbot Laboratories
<u>Analysis Date</u>	7/86	6/87
<u>Site 2 (0-3")</u>		
Total Lead	9,822	9,437.9
EP Toxicity - Lead	68.80	4.97
<u>Site 2 (3-6")</u>		
Total Lead	1,702	2,806.3
EP Toxicity - Lead	0.21	0.77
<u>Site 3 (0-3")</u>		
Total Lead	24,344	17,968.4
EP Toxicity - Lead	23.40	168.8
<u>Site 3 (3-6")</u>		
Total Lead	2,858	9,063.1
EP Toxicity - Lead	4.20	35.4
<u>Site 4 (0-3")</u>		
Total Lead	5,922	6,645.5
EP Toxicity - Lead	13.00	106.4
<u>Site 4 (3-6")</u>		
Total Lead	26,040	13,996.2
EP Toxicity - Lead	3.70	6.10
<u>Site 5 (0-3")</u>		
Total Lead	13,064	17,953.2
EP Toxicity - Lead	315.00	188.0
<u>Site 5 (3-6")</u>		
Total Lead	27,895	65,107.2
EP Toxicity - Lead	0.24	325.0

	<u>Sample Set 3</u>	<u>Sample Set 3 (Repeat analysis)</u>
	CH2M-Hill	Talbot Laboratories
<u>Analysis Date</u>	7/86	6/87
<u>Site 6 (0-3")</u>		
Total Lead	1,398	788.3
EP Toxicity - Lead	7.70	8.59
<u>Site 6 (3-6")</u>		
Total Lead	2,074	4,215.8
EP Toxicity - Lead	6.20	35.1
<u>Site 9 (0-3")</u>		
Total Lead	1,901	1,706.3
EP Toxicity - Lead	175.00	4.33
<u>Site 9 (3-6")</u>		
Total Lead	96	30.87
EP Toxicity - Lead	0.20	0.02
<u>Site 10 (0-3")</u>		
Total Lead	1,214	1,547.9
EP Toxicity - Lead	3.80	26.7
<u>Site 10 (3-6")</u>		
Total Lead	50	8.49
EP Toxicity - Lead	LT 0.08	LT 0.01
<u>Site 12 (0-3")</u>		
Total Lead	1,469	837.0
EP Toxicity - Lead	2.60	18.1
<u>Site 12 (3-6")</u>		
Total Lead	153	51.89
EP Toxicity - Lead	0.12	0.03
<u>Site 16 (0-3")</u>		
Total Lead	1,162	1,454.7
EP Toxicity - Lead	4.60	0.09

	<u>Sample Set 3</u>	<u>Sample Set 3 (Repeat analysis)</u>
<u>Analysis Date</u>	CH2M-Hill	Talbot Laboratories
<u>Site 16 (3-6")</u>	7/86	6/87
Total Lead	132	159.1
EP Toxicity - Lead	LT 0.08	LT 0.01

Total lead in mg/kg (ppm)
 EP lead in mg/l (ppm)
 LT = Less Than

APPENDIX 4

ADEM CORRESPONDENCE - 1/8/88

(REVIEW OF GROUNDWATER CONDITIONS)

ADEM

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT



Guy Hunt
Governor

Leigh Pegues, Director January 8, 1988

751 Federal Drive
Montgomery, AL
36130
205/271-7700

Mr. Jeffrey Leed
Exide Corporation
645 Penn St.
Reading, PA 19601

Field Offices:

Unit 806, Building 8
225 Oxmoor Circle
Birmingham, AL
35209
205/942-6168

Dear Mr. Leed:

RE: General Battery Corporation, Selma, Alabama

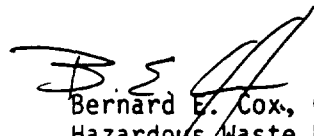
P.O. Box 953
Decatur, AL
3602
205/353-1713

The ADEM Groundwater Section has reviewed the information submitted by General Battery/Exide for the Selma, Alabama, plant. Comments and recommendations can be found on the attached memorandum.

204 Perimeter Road
Mobile, AL
36615
205/479-2336

Should you have any questions regarding this matter, please call Fred Mason (205/271-7831) or W. B. Turk (205/271-7737).

Sincerely,


Bernard E. Cox, Chief
Hazardous Waste Branch
Land Division

BEC/FM/vrh

Enclosure

cc: Fred Mason, Groundwater Section
Scott Gowney, Morgan, Lewis & Bockius

File: Generator

General Battery Corporation
RECEIVED

JAN 13 1988

Environmental Management Division

ADEM

ALABAMA

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

December 22, 1987



Guy Hunt
Governor

Leigh Pegues, Director MEMORANDUM

51 Federal Drive
Montgomery, AL
36130
205/271-7700

TO: Bernard E. Cox, Chief
Hazardous Waste Branch

Field Offices:

FROM: Fred C. Mason III, Geologist *FCM*
Groundwater Section

1806, Building B
5 Oxmoor Circle
Birmingham, AL
35209
5/842-6168

RE: General Battery File Review

P.O. Box 953
Birmingham, AL
35202
205/363-1713

At the request of General Battery Corporation representatives, Greg Goodman, CH2M Hill, and Scott Gowney, attorney, Excide Corp., I have reviewed the file to determine if additional work will be required in 1988. My review indicates that groundwater contamination does exist on site in the form of lead, arsenic, and chromium levels that exceed primary drinking water standards.

34 Perimeter Road
Birmingham, AL
35215
205/479-2336

CH2M Hill and General Battery contend that dissolved metals in the groundwater are lower than the primary drinking water standards. Contacts with Joe Marsh of the ADEM lab indicate that the test method of lead and other metals does not include filtration of samples but is reported as total lead resulting from the digestion method of analysis. As a result, the total metals must be compared to the standards when making a determination of whether groundwater quality degradation has occurred from plant activities.

I have, as a result of these conclusions, evaluated the submitted groundwater monitoring data (see attachments) and determined that levels of lead, arsenic, and chromium were in excess of standards in most samples. I also noted that assessment of the hydrogeology has not been conducted. The following recommendations are therefore submitted.

1. General Battery must continue monitoring on a quarterly basis.
2. They must establish the rate of movement and the vertical and horizontal extent of the contaminant plume.
3. They must evaluate the impact on groundwater resources by conducting a water well inventory in the surrounding area and establishing the hydrogeologic characteristics of the aquifer.
4. Consideration of background groundwater quality and statistical evaluation is recommended.
5. This evaluation must include presentation of data in standard hydrogeological format i.e. contour mapping, hydrogeological cross sections etc.

I have relayed this conclusion to the General Battery representatives via telephone and indicated a followup letter would be forwarded as soon as possible.

FM/vrh

cc: Margaret Corey

APPENDIX 5

INFORMATION RELATED TO 1987 SOIL EXCAVATION/TESTING
ALONG WEST SIDE OF EXIDE BUILDING

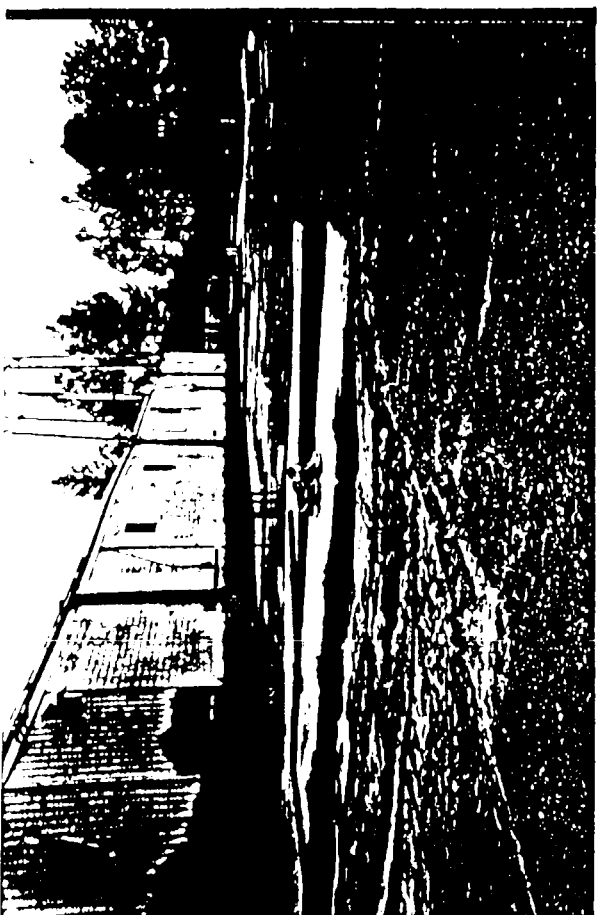
NOTES

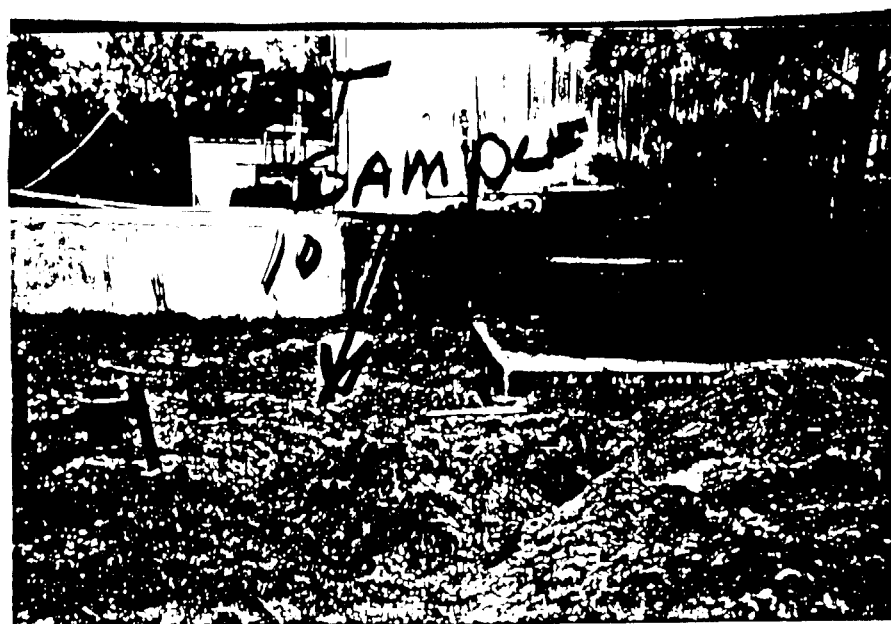
SOIL SAMPLE

- 10 DENOMINATE
SOIL SAMPLE
LOCATION AND
NUMBER

SAMPLES COLLECTED 10/20







Air Sampling
Industrial Hygiene
Laboratory Work Report
CDC Licensed
AIHA Accredited

EXIDE

6313 Rising Sun Avenue
Philadelphia, PA 19111
215/342-1414

RECEIVED

NOV 17 1987

GEORGE S. HARTMAN

Location: _____ Date Received: _____ Date Analyzed: _____ Date Reported: _____ Technician: _____

RIHA 1119 On Exide-Solma

10-26-87

11-13-87

11-13-87

11-13-87

Cassette Sample No.	Clock No.	Name	Sample Site-Location	Remarks	Date Taken	Sample Rate (LPM)	Sample Time (min)	Air Lead Level ($\mu\text{g}/\text{cu. meter}$)	Air Arsenic Level ($\mu\text{g}/\text{cu. meter}$)	Other Notes
1					10-26-87					30.
2										456.
3										453675.
4										56.
5										56.
6										56.
7										
8										

Air Sampling
Industrial Hygiene
Laboratory Work Report
CDC Licensed
AIHA Accredited

EXIDE

6313 Rising Sun Avenue
Philadelphia, PA 19111
215/342-1414

RECEIVED

NOV 17 1987

GEORGE S. HARTMAN

Location: W40 H60 Co (Exide-Solmag) Date Received: 10-28- Date Analyzed: 11-13-87 Date Reported: 11-13-87 Technician: RS

Cassette Sample No.	Clock No.	Name	Sample Site Location	Remarks	Date Taken	Sample Rate (LPM)	Sample Time (min)	Air Lead Level (µg/cu. meter)	Air Arsenic Level µg/cum	Other PPM LEAD
9					10-26-87					24.
10					"					63.
11					"					337461.
12					"					97.
A		While digging			"					451307.
B		While digging			"					373476.
C		While digging			"					177596.
D		While digging			"					319456.

6313 Rising Sun Avenue
Philadelphia, PA 19111
215/342-1414

11110 1140 - Co (Exide-Solma)

10-28-87

44-1-13-87

211-13-87

PC

Copy 1 - White - Industrial Hygiene Laboratory File Copy
Copy 2 - Green - Plant Manager/Location



March 18, 1988

ANALYSIS OF SAMPLES SUBMITTED - MARCH 14, 1988

Samples Submitted By: Exide Corporation
Jeff Leed

Sample Origin: Selma, Alabama

Sample Identification: Soil Sample #3, #11

	<u>Soil Sample # 3</u>	<u>Soil Sample #11</u>
Lead, Total (mg/kg)	2.03	2.60
Lead, E.P. Toxicity (mg/l)	< 0.007	< 0.007

< = Less Than

Exide Corporation
P. O. Box 1262
Reading, PA 19603

ATTN: Jeff Leed

LAB WORK ORDER #47757

B.O.#4410-801-A

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Operations Manager

APPENDIX 6

DISPOSAL AUTHORIZATION REQUEST AND PURCHASE ORDERS
FOR TRANSPORTATION AND DISPOSAL OF EXCAVATED SOIL
AND SAND AT CHEMICAL WASTE MANAGEMENT LANDFILL,
EMEULE, ALABAMA

February 10, 1988

Chemical Waste Management, Inc.
Emelle Facility
ATTN: Action of Approval
P. O. Box 55
Emelle, Alabama 35459

RE: Exide/General Battery Corporation; Selma, Alabama
Request for Disposal Authorization/Quotation

Dear Sir:

Enclosed is a completed Chemical Waste Management, Inc. Generator's Waste Material Profile Sheet for lead-containing soil/sand generated at Exide/General Battery Corporation's facility in Selma, Alabama. Please provide this office with the necessary disposal authorization and appropriate cost information for disposal of this material.

Mr. Rod Sanders of WHO Manufacturing in Selma, Alabama has advised this office that he has spoken to Ms. Sarah Walton at the Emelle facility and that completion of the certification of representative sample form is not required for this waste. A copy of laboratory data from recent tests performed on a composite sample of the waste are attached for review.

Please provide disposal authorization and a quotation to this office as soon as possible. Should additional information be required, please contact this office at (215) 378-0852.

Very truly yours,

EXIDE/GENERAL BATTERY CORPORATION

Jeffrey A. Leed

Jeffrey A. Leed
Director - Waste Management

JAL:sb

2/11 2/24/88 *[Signature]* 2/22
cc: J. Baranski/D. Ferrante/G. Hartman/J. Bitler - w/attach.
R. Restrepo - w/o attach.
R. Sanders - w/attach.



Chemical Waste Management, Inc.

GENERATOR'S WASTE MATERIAL PROFILE SHEET WORKSET



Return this completed workset to:

CHEMICAL WASTE MANAGEMENT, INC.

ATTN: ACTION OF APPROVAL

P.O. Box 55

EMELLE, ALABAMA 35459

GENERAL INSTRUCTIONS

This workset contains two forms:

- GENERATOR'S WASTE MATERIAL PROFILE SHEET
- GENERATOR'S CERTIFICATION OF REPRESENTATIVE SAMPLE

1. The Generator's Waste Material Profile Sheet is a two-sided form. Both sides must be completed.
2. This document is perforated so the forms and instructions may be separated for your convenience. If the forms are separated, take special precautions to assure that they are used to describe and identify **ONLY** the same waste.
3. Shaded areas on the forms are for Chemical Waste Management use only.
4. Answers must be made to all questions with the exception of PART I, "Reclamation, Fuels or Incineration Parameters," which is optional.
5. Answers must be printed in ink or typed (elite, 12-pitch).
6. Instructions are included to help you complete these forms correctly. The letters and numbers which precede each instruction refer to the lettered and numbered entries on the forms.
7. Both the Generator's Waste Material Profile Sheet and the Generator's Certification of Representative Sample forms must be signed.
8. The Certification of Representative Sample and its peel off Sample Label must be used to identify **ONLY** the sample of the waste described on the attached Generator's Waste Material Profile Sheet.
9. The peel off label must be completed before removal from the form and applied to the container which actually holds the sample material - not on the shipping carton - even if the sample already has another label.
10. If you have any questions concerning the use of these forms, please contact your Chemical Waste Management Sales Representative or the office that issued this workset to you.
11. **MAKE A COPY OF THESE FORMS FOR YOUR RECORDS. SEND THE ORIGINALS AND ALL ATTACHMENTS TO THE ADDRESS SHOWN ABOVE OR TO THE ADDRESS PROVIDED BY YOUR CHEMICAL WASTE MANAGEMENT, INC. SALES REPRESENTATIVE.**



GENERATOR'S WASTE MATERIAL PROFILE SHEET



This information is required for a waste to be considered for transportation, treatment, storage or disposal. It is used to determine if the waste may be transported, treated, stored or disposed in a legal, safe, and environmentally sound manner. This information will be maintained in strict confidence. **ANSWERS MUST BE MADE TO ALL QUESTIONS** and must be printed in ink or typed (elite, 12-pitch). A response of "NONE," or "NA" can be made if appropriate.

Shaded areas are for CWM use only.

PART A. GENERAL INFORMATION

1. GENERATOR NAME - Enter the name of the generating facility.
2. GENERATOR USEPA ID - Enter the twelve character alpha-numeric descriptor issued by the USEPA to the facility generating the waste.
3. FACILITY ADDRESS - Enter the street address (not P.O. Box) of the generating facility.
4. GENERATOR STATE ID - Enter the descriptor issued by the state to the facility generating the waste (if applicable).
5. ZIP CODE - Enter the generating facility's five or nine digit zip code.
6. TECHNICAL CONTACT - Enter the name of a person who will answer technical questions about the waste.
7. TITLE - Enter technical contact's title.
8. PHONE - Enter technical contact's telephone number.

PART B. MAIL CHEMICAL WASTE MANAGEMENT INC. INVOICES TO:

1. If you want the invoice mailed to the same address as in PART A, check "Generating Facility." If you want the invoices mailed elsewhere, then indicate the name, phone, and address, as shown in numbers 2 through 5.
2. COMPANY NAME - Enter the name of the company to which you want the invoices sent.
3. PHONE - Enter the telephone number of the company to which you want the invoices sent.
4. ADDRESS - Enter the address of the company to which you want the invoices sent.
5. ZIP CODE - Enter the five or nine digit zip code of the company to which you want the invoices sent.

PART C.

1. NAME OF WASTE - Enter a name that is generally descriptive of this waste (e.g., cyanide plating waste, paint sludge, PCB contaminated dirt, still bottoms, wastewater treatment sludge).
2. PROCESS GENERATING WASTE - List the specific process/operation or source that generates the waste (e.g., metal plating operation, paint spray booth, PCB spill, solvent recovery, wastewater treatment plant).
3. DIOXIN WASTE - Treatment, storage or disposal of Dioxin wastes requires special attention. If this waste is a USEPA listed Dioxin waste, indicate "YES" and contact your Chemical Waste Management Sales Representative. If "YES", **DO NOT COMPLETE THE REMAINDER OF THIS FORM.**

PART D. PHYSICAL CHARACTERISTICS OF WASTE

1. COLOR - Describe the color of the waste (e.g., blue, clear, varies).
2. ODOR - **DO NOT SMELL THE WASTE!** If the waste has a known incidental odor, then describe it (e.g., acrid, pungent, solvent, sweet).
3. PHYSICAL STATE - If the four boxes provided do not apply, a descriptive phrase may be entered after "Other" (e.g., gas).
4. LAYERS - Check all applicable boxes. Multi-layered means more than two layers (e.g., oil/water/sludge). Bi-layered means the waste is comprised of two layers which may or may not be of the same phase (e.g., oil/water, solvent/sludge). Single phased means the waste is homogeneous.
5. SPECIFIC GRAVITY - Indicate the range. The specific gravity of water is 1.0. Most organics are less than 1.0. Chlorinated solvents, most inorganics and paint sludge are greater than 1.0.
6. FREE LIQUIDS - Check "YES" if liquid is usually present when packaging for shipment and estimate the percent of liquid volume. Check "NO" if there are no free liquids as defined by the Paint Filter Test (SW 846 Method 9095).
7. pH - Indicate for liquid or liquid portions of the waste. Check the appropriate boxes which cover the pH of the waste. Use the "Range" space if appropriate. For solid or organic liquid wastes, indicate the pH of a 10% aqueous solution of the waste if applicable. Check "NA" for non-water soluble materials (e.g., bricks, dismantled tanks, empty drums, gases, rocks).
8. LIQUID FLASH POINT - Indicate the liquid flash point obtained using the appropriate testing method (40CFR261.21). The liquid flash point is important from a transportation standpoint (49CFR173.115). Solids with flammable potential should be identified in PART H.3 (e.g., Pyrophoric, RCRA Reactive, Other).

PART E. CHEMICAL COMPOSITION

1. List all organic and/or inorganic components of the waste using specific chemical names. If trade names are used, attach Material Safety Data Sheets or other documents which adequately describe the composition of the waste. For each component, estimate the range (in percents) in which the component is present. In case of extreme pH (2 or less or 12.5 or greater) indicate specific acid or caustic species present. This list must include any hazardous components listed in PARTS F, G, and/or H which exceed 10,000 ppm (1%). The total of the maximum values of the components must be greater than or equal to 100% including water, earth, etc.
2. If this waste contains PCBs, cyanides, phenolics or sulfides, indicate the concentration(s). If this waste does not contain these constituents, indicate by checking the "NONE" box(es) which apply. If the concentration of these constituents is unknown, please indicate "UNK" under "ACTUAL."

PART F. METALS

Indicate whether metals content was determined by EP Tox (extraction procedure toxicity)/TCLP (Toxicity Characteristics Leaching Procedure) from 40CFR261-Appendix II or represents the total metals. For each metal, check only one box indicating that the metal content will not exceed the stated amount or enter the actual metal content indicated by your test results in the "ACTUAL" column in parts per million. If you know a metal is NOT present, indicate by writing "NA" under "ACTUAL." An actual concentration of zero is not appropriate. If metal concentrations are unknown, please indicate "UNK" under "ACTUAL."

PART G. OTHER HAZARDOUS CHARACTERISTICS

1. Indicate by checking the appropriate box.
2. Indicate by checking the appropriate box. If "YES," indicate the concentration in PART E.
3. Indicate if this waste is any of the following:
RCRA REACTIVE - As defined by 40CFR261.
WATER REACTIVE - Reacts violently with water to form toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.



Chemical Waste Management, Inc.



EXPLOSIVE - Capable of detonation or explosive reaction if subjected to a strong initiating source or if heated under confinement, a Class A explosive (49CFR173.53), or a Class B explosive (49CFR173.88).

SHOCK SENSITIVE - Normally unstable and readily undergoes violent change without detonating.

PYROPHORIC - Will ignite spontaneously in air at or below 130°F (54.4°C) (49CFR173.115).

RADIOACTIVE - Any material, or combination of materials, that has a specific activity greater than 0.002 microcuries per gram (49CFR173.403).

ETIOLOGICAL - A viable microorganism or its toxin which causes or may cause human disease (49CFR173.386).

PESTICIDE MANUFACTURING WASTE - Waste resulting from the manufacture of pesticides or the potential precursors of pesticides.

OTHER - Indications of other hazardous characteristics must be included (e.g., autopolymerization, peroxide-forming).

NONE OF THE ABOVE - Check this box if it is applicable for this waste.

PART H

Complete **ONLY** for wastes intended for fuels or incineration. If present, indicate the concentration as appropriate. If the concentrations of these constituents are unknown, please indicate "UNK" under "ACTUAL."

The following section lists parameters and suggested analytical methods that may be used in obtaining these values:

Parameter	Source
Beryllium, Potassium, Sodium	SW846-6010, 7090, 7610, 7770
Total Bromine, Chlorine, Fluorine	ASTM D2361-85, D4327-84, D808-81
Total Sulfur	ASTM D 2361-85, D516-82

PART I. OPTIONAL - RECLAMATION, FUELS OR INCINERATION PARAMETERS

Please provide this optional information where known. The following parameters and suggested analytical methods may be used in obtaining these values:

Parameters	Source
1. Heat Value (BTU/lb)	ASTM D 240-85, D2015-85
2. Percent Water	ASTM D 4006-81, E203-75
3. Viscosity	Any method
4. Percent Ash	ASTM D 482-80
5. Settleable Solids	Any method
6. Vapor Pressure	Any method
7. Indicate if this waste can be transferred by pumping at an ambient temperature of 50°F. If "YES," list the type of pump required (centrifugal, gear, peristaltic, etc.).	
8. Indicate if an external source of heat can be safely used to improve the flow of this waste.	
9. Indicate if this waste is soluble in water.	
10. PARTICLE SIZE - If the waste contains any solids, indicate if they can pass through a 1/8" screen.	

PART J. TRANSPORTATION INFORMATION

1. Indicate if this waste is a USDOT Hazardous material (49CFR172.101).
2. Anticipated Annual Volume/Units - Enter the amount of this waste which will be generated and transported annually. Use appropriate units to describe this volume (e.g., cubic yards, gallons, kilograms, pounds).
3. Proper Shipping Name - Enter the proper USDOT shipping name for this waste (49CFR172.101).
4. Hazard Class - Enter the proper USDOT hazard class (49CFR172.101).
5. I.D. # - Enter the proper USDOT Identification Number (49CFR172.101).
6. Additional Description - Enter any additional shipping information required (49CFR172.203) (e.g., "RQ", the names of Hazardous Substance Constituents as they would appear on the Uniform Hazardous Waste Manifest and the packaging).
7. Method of Shipment - Indicate the anticipated method(s) of shipment by checking the appropriate box(es). If drums are to be used, see 49CFR173 for DOT drum specifications.
8. CERCLA Reportable Quantity (RQ) - Enter the Reportable Quantity for this waste from 49CFR172.101 or 40CFR302.
9. RQ Units (lb/kg) - Indicate the appropriate units for the RQ listed in #8.
10. USEPA Hazardous Waste - Indicate if this waste is a USEPA Hazardous Waste (40CFR261).
11. USEPA Hazardous Waste Number(s) - If the answer to question #10 was "YES," then enter the appropriate USEPA Hazardous Waste Number(s) (e.g., D002, F002, K028, P006, U220) (40CFR261).
12. State Hazardous Waste - Indicate if this waste is a hazardous waste as defined by the state in which it is now located.
13. State Hazardous Waste Number(s) - If the answer to question #12 was "YES," then enter the appropriate State Hazardous Waste Number(s) (e.g., for a waste now in California: 212, 213).

PART K. SPECIAL HANDLING INFORMATION

Describe those hazards which you know or reasonably believe are or may be associated with short term or prolonged human exposure to this waste (29CFR1910.1200). If known, please identify any carcinogens present in this waste in excess of 0.1% (29CFR1910.1200 (d)(4)). Attach relevant documents as a part of your response if appropriate. If documents are attached, identify those attachments. If you have a current Material Safety Data Sheet, it may be attached. Failure to make an entry in PART K is considered to be a representation that you neither know nor believe that there are any adverse human health effects associated with exposure to this waste.

Also include in PART K any additional information that will aid in the management of the waste (e.g., protective clothing, transportation, treatment, storage, disposal).

PART L. GENERATOR CERTIFICATION

An authorized employee of the generator must sign and date this certification on the completed Generator's Waste Material Profile Sheet.

MAKE A COPY OF THIS GENERATOR'S WASTE MATERIAL PROFILE SHEET FOR YOUR RECORDS. SEND THE ORIGINAL AND ATTACHMENTS TO THE ADDRESS SHOWN ON THE FRONT OF THIS WORK SET OR TO THE ADDRESS PROVIDED BY YOUR CHEMICAL WASTE MANAGEMENT, INC. SALES REPRESENTATIVE.



GENERATOR'S WASTE MATERIAL PROFILE SHEET

PLEASE PRINT IN INK OR TYPE (Elite, 12-pitch).



* EXIDE/GENERAL BATTERY CORPORATION
P.O. BOX 14205
READING, PA. 19612-4205



#H17357#

MAR 4 17357

Waste Profile Sheet Code

CWM Location of Original: _____

(SHADED AREAS FOR CWM USE ONLY)

CWM Sales Rep. #: _____

A. GENERAL INFORMATION

1. Generator Name: EXIDE/GENERAL BATTERY CORPORATION 2. Generator USEPA ID: ALD034104646
3. Facility Address: OLD MONTGOMERY HIGHWAY 4. Generator State ID: NOT APPLICABLE
SELMA, ALABAMA 5. Zip Code: 36701
6. Technical Contact: JEFFREY A. LEED* 7. Title: DIRECTOR - WASTE MANAGEMENT 8. Phone: (215) 378-0852

B. MAIL CHEMICAL WASTE MANAGEMENT, INC. INVOICES TO

1. ☐ Generating Facility (A, above), or
2. Company Name: EXIDE/GENERAL BATTERY CORPORATION 3. Phone: (215) 378-0500
4. Address: ATTN: ACCOUNTS PAYABLE DEPARTMENT
P.O. BOX 14205
READING, PA. 5. Zip Code: 19612-4205

C. 1. NAME OF WASTE LEAD-CONTAINING SOIL/SAND2. PROCESS GENERATING WASTE PLANT CLOSURE/CLEAN-UP.

3. Is this waste a Dioxin listed waste as defined in 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, or F028)?

☐ Yes ☒ No If yes, DO NOT COMPLETE this form. Contact your Chemical Waste Management, Inc. sales representative for assistance.

D. PHYSICAL CHARACTERISTICS OF WASTE

1. Color: <u>BROWN</u>	2. Does the waste have a strong incidental odor? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes If known, describe: _____	3. Physical State @ 70°F: <input checked="" type="checkbox"/> Solid <input type="checkbox"/> Semi-Solid <input type="checkbox"/> Liquid <input type="checkbox"/> Powder Other: _____	4. Layers: <input type="checkbox"/> Multilayered <input type="checkbox"/> Bi-layered <input checked="" type="checkbox"/> Single Phased	5. Specific Gravity: Range: <u>1.0 (ESTIMATED)</u>	6. Free Liquids: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Volume: _____ %
---------------------------	---	---	---	---	--

7. pH: ☐ ≤ 2 ☐ > 2-4 ☒ 4-7 ☐ 7 ☐ 7-10 ☐ 10- < 12.5 ☐ ≥ 12.5 ☐ Range ACTUAL 6.9 ☐ NA8. Liquid Flash Point: ☐ < 73°F ☐ 73-99°F ☐ 100-139°F ☐ 140-199°F ☐ ≥ 200°F ☒ None ☐ Closed Cup ☐ Open Cup

E. CHEMICAL COMPOSITION

	RANGE		
	MIN.	MAX.	
1. <u>LEAD</u>	<u>3</u>	<u>5</u>	%
<u>OTHER METALS</u>	<u>0</u>	<u>1</u>	%
<u>SOIL/SAND</u>	<u>94</u>	<u>97</u>	%
	-	-	%
	-	-	%
	-	-	%
	-	-	%
	-	-	%
	-	-	%
	-	-	%
	-	-	%

Please note: The chemical composition total in the maximum column must be greater than or equal to 100%.

TOTAL: 103 %

2. Indicate if this waste contains any of the following:

	NONE	or	LESS THAN	or	ACTUAL
PCB's	<input checked="" type="checkbox"/>		< 50 ppm		ppm
Cyanides	<input checked="" type="checkbox"/>		< 50 ppm		ppm
Phenolics	<input checked="" type="checkbox"/>		< 50 ppm		ppm
Sulfides	<input checked="" type="checkbox"/>		< 50 ppm		ppm

F. METALS Indicate if this waste contains any of the following:

METAL	1. <input checked="" type="checkbox"/> EP TOX/TCLP	or	2. <input type="checkbox"/> Total	LESS THAN	or	ACTUAL
				(Parts Per Million)		
Arsenic	<input type="checkbox"/> < 5		<input type="checkbox"/> < 500			<u>0.030</u>
Barium	<input type="checkbox"/> < 100					<u>< 1.0</u>
Cadmium	<input type="checkbox"/> < 1		<input type="checkbox"/> < 100			<u>< 0.05</u>
Chromium	<input type="checkbox"/> < 5					<u>< 0.05</u>
Lead	<input type="checkbox"/> < 5		<input type="checkbox"/> < 500			<u>5.9</u>
Mercury	<input type="checkbox"/> < 0.2		<input type="checkbox"/> < 20			<u>< 0.001</u>
Selenium	<input type="checkbox"/> < 1		<input type="checkbox"/> < 100			<u>0.010</u>
Silver	<input type="checkbox"/> < 5					<u>< 0.05</u>
Chromium-Hex	<input checked="" type="checkbox"/> < 5		<input type="checkbox"/> < 500			
Copper	<input checked="" type="checkbox"/> < 5					
Nickel	<input checked="" type="checkbox"/> < 5		<input type="checkbox"/> < 134			
Thallium	<input checked="" type="checkbox"/> < 5		<input type="checkbox"/> < 130			
Zinc	<input checked="" type="checkbox"/> < 5					

GENERATOR'S WASTE MATERIAL PROFILE SHEET (Continued)

 H 17357

Waste Profile Sheet Code

G. OTHER HAZARDOUS CHARACTERISTICS

1. Is this waste a listed solvent waste as defined by 40 CFR 261.31 (F001, F002, F003, F004, or F005)? ☐ Yes ☒ No
2. Does this waste contain greater than 1000 ppm total halogenated organic compounds? ☐ Yes ☒ No
3. Indicate if this waste is any of the following:

<input type="checkbox"/> RCRA Reactive	<input type="checkbox"/> Radioactive
<input type="checkbox"/> Water Reactive	<input type="checkbox"/> Etiological
<input type="checkbox"/> Explosive	<input type="checkbox"/> Pesticide Manufacturing Waste
<input type="checkbox"/> Shock Sensitive	<input checked="" type="checkbox"/> Other <u>EP TOXIC (LEAD)</u>
<input type="checkbox"/> Pyrophoric	<input type="checkbox"/> None of the above

H. COMPLETE ONLY FOR WASTES INTENDED FOR FUELS or INCINERATION

	LESS THAN	or	ACTUAL
Beryllium	<input type="checkbox"/> < 5000 ppm		_____ ppm
Potassium	<input type="checkbox"/> < 5000 ppm		_____ ppm
Sodium	<input type="checkbox"/> < 5000 ppm		_____ ppm
Total Bromine	<input type="checkbox"/> < 2 %		_____ %
Total Chlorine	<input type="checkbox"/> < 35 %		_____ %
Total Fluorine	<input type="checkbox"/> < 1 %		_____ %
Total Sulfur			_____ %

NOT APPLICABLE

I. OPTIONAL — RECLAMATION, FUELS, OR INCINERATION PARAMETERS Provide if information is available. NOT APPLICABLE

1. Heat Value (BTU/lb): _____ Range _____
2. Water: _____ %
3. Viscosity (cps): _____ @ ☐ _____ °F ☐ 100°F ☐ 150°F
4. Ash: _____ %
5. Settleable solids: _____ %
6. Vapor Pressure @ STP (mm/Hg): _____
7. Is this waste a pumpable liquid? ☐ Yes ☐ No
Type of pump? _____
8. Can this waste be heated to improve flow? ☐ Yes ☐ No
9. Is this waste soluble in water? ☐ Yes ☐ No
10. Particle size: Will the solid portion of this waste pass through a 1/8 inch screen? ☐ Yes ☐ No

J. TRANSPORTATION INFORMATION

1. Is this a DOT Hazardous Material? ☒ Yes ☐ No
2. Anticipated Annual Volume/Units: 10 / TONS
3. Proper Shipping Name: RG, HAZARDOUS WASTE, SOLID, NOS (LEAD)
4. Hazard Class: ORM-E
5. I.D. #: NA9189
6. Additional Description: (NOT APPLICABLE)
7. Method of Shipment: ☐ Bulk Liquid ☒ Bulk Solid ☐ Drum (Type/Size): _____ / _____ Other: _____
8. CERCLA Reportable Quantity (RQ): 1
9. RQ Units (lb/kg): POUND
10. USEPA Hazardous Waste? ☒ Yes ☐ No
11. USEPA Hazardous Waste Number(s): D008
12. State Hazardous Waste? ☒ Yes ☐ No
13. State Hazardous Waste Number(s): D008

K. SPECIAL HANDLING INFORMATION

HANDLE TO MINIMIZE AIRBORNE SUSPENSION OF DUST.

(ANALYTICAL DATA - ATTACHED)

☒ Additional Page(s) Attached

L. GENERATOR CERTIFICATION I hereby certify that all information submitted in this and all attached documents contains true and accurate descriptions of this waste material, and all relevant information regarding known or suspected hazards in the possession of the generator has been disclosed.

1. Jeffrey A. Leed
Signature
2. DIRECTOR - WASTE MANAGEMENT
Title
3. JEFFREY A. LEED
Name (Type or Print)
4. 2/4/88
Date



Chemical Waste Management, Inc.
GENERATOR'S CERTIFICATION OF REPRESENTATIVE SAMPLE
PLEASE PRINT IN INK OR TYPE (Elite, 12-pitch).



H17357



H 17357

Waste Profile Sheet Code

CWM Location of Original: _____

(SHADED AREAS FOR CWM USE ONLY)

CWM Sales Rep. #: _____

This completed form must be returned, with the representative sample, to:

INSTRUCTIONS FOR COMPLETING THIS FORM ARE FOUND ON THE OPPOSITE SIDE. In order to determine whether Chemical Waste Management, Inc. can accept the special waste described in the Generator's Waste Material Profile Sheet referenced above, you must obtain and supply us with a representative sample of the waste. We may analyze the sample to verify the information that you have provided to us. A representative sample is defined as a sample obtained using any of the applicable sampling methods specified in 40 CFR 261-Appendix I or an equivalent method. Collect a representative sample of your waste and complete the form below. Apply the peel off label and ship your sample along with this form to the address noted above. If you have any questions regarding obtaining a representative sample of your waste, please refer to the instructions for this form, or contact your Chemical Waste Management, Inc. sales representative.

A. SAMPLING METHOD (Indicate which method was employed)

If sampling requirement has been waived by Chemical Waste Management, Inc., do not complete this Generator's Certification of Representative Sample form.

1. ☐ I have obtained a representative sample of the waste material described in the Generator's Waste Material Profile Sheet referenced above according to the sampling methods specified in 40 CFR 261-Appendix I.
2. ☐ I have obtained a representative sample of the waste material described in the Generator's Waste Material Profile Sheet referenced above using a method equivalent to the sampling methods described in 40 CFR 261-Appendix I.

B. SAMPLE SOURCE (e.g., drum, lagoon, pit, pond, tank, vat)

C. SAMPLE LABEL — COMPLETE LABEL BEFORE REMOVING



H17357

- | | |
|------------------------------------|------------------------------------|
| 1. Waste Profile Sheet Code: _____ | 1. Waste Profile Sheet Code: _____ |
| 2. Generator's Name: _____ | 2. Generator's Name: _____ |
| 3. Name of Waste: _____ | 3. Name of Waste: _____ |
| 4. Sample Hour/Date: _____ | 4. Sample Hour/Date: _____ |
| 5. Sampler's Signature: _____ | 5. Sampler's Signature: _____ |

6. Print Sampler's Name: _____
7. Sampler's Title: _____
8. Sampler's Employer (if CWM, see D. below): _____

D. WITNESS VERIFICATION (if required) In most circumstances you will be obtaining the sample. However, in those cases in which Chemical Waste Management, Inc. obtains the sample, one of your employees must be present to direct the particular source to be sampled, to witness the sampling, and to complete this Part D.

I was personally present during the sampling described. I directed the waste source to be sampled, and I verify the information noted above.

- | | |
|------------------------------|--------------------------|
| 1. Witness' Signature: _____ | 3. Witness' Title: _____ |
| 2. Witness' Name: _____ | 5. Date: _____ |
| 4. Witness' Employer: _____ | |



Chemical Waste Management, Inc.

GENERATOR'S CERTIFICATION OF REPRESENTATIVE SAMPLE



Shaded areas are for CWM use only.

PART A. SAMPLING METHOD

Questions concerning sample waiver should be referred to your Chemical Waste Management, Inc. Sales Representative.

Check the sampling method employed.

This sample should be collected in accordance with "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods", SW846, USEPA, Office of Solid Waste, Washington, D.C. 20460 and/or 40CFR261-Appendix I. A suitable sample container for most wastes is a wide mouth glass bottle with a plastic cap having a non-reactive liner. Plastic containers are recommended for strong caustics or fluorides. Fill to approximately 90% of capacity to allow for expansion during transportation. The peel off label on this form must be completed prior to removal from the form. Ultimately, the label must be attached to the sample container, not the shipping container.

If this waste is a hazardous material, the sample must be packaged and shipped in accordance with USDOT regulations (49CFR171.2) and any specific requirements imposed by the carrier. Improperly packaged samples may be disposed of upon receipt.

PART B. SAMPLE SOURCE

The sampler is to describe exactly from where the sample was taken (e.g. conveyor, drum, lagoon, pipe, pit, pond, tank, vat).

PART C. SAMPLE LABEL

THE SAMPLE LABEL MUST BE COMPLETED BEFORE IT IS REMOVED FROM THIS FORM

Apply the completed peel off label to the container which actually holds the sample - not to the shipping carton. DO NOT WRITE ON THE BAR CODE (if present).

1. WASTE PROFILE SHEET CODE - If not preprinted, enter the appropriate Waste Profile Sheet Code. This Certification and its peel off label must be used to identify **ONLY** the sample of the waste described in the Generator's Waste Material Profile Sheet bearing the same Waste Profile Sheet Code.
2. GENERATOR'S NAME - Enter the name of the generating facility.
3. NAME OF WASTE - Enter a name which is generally descriptive of this waste (e.g., cyanide plating waste, paint sludge, PCB contaminated dirt, still bottoms, wastewater treatment sludge) as it appears on the Generator's Waste Material Profile Sheet.
4. SAMPLE HOUR/DATE - Enter the hour and date sample was collected.
5. SAMPLER'S SIGNATURE - The sampler must sign in the space provided.
6. PRINT SAMPLER'S NAME - Enter the sampler's name.
7. SAMPLER'S TITLE - Enter the sampler's title.
8. SAMPLER'S EMPLOYER (If CWM, See D. Below) - Enter the sampler's employer's name.

Remove the completed peel off label and affix it to the sample container at the time of sampling. If this label is lost or destroyed, the sample must be labeled with equivalent information, including the Waste Profile Sheet Code. If the Certification of Representative Sample Form is lost or destroyed, please contact your Chemical Waste Management, Inc. Sales Representative to obtain a new one.

PART D. WITNESS VERIFICATION (If required):

In the event that a Chemical Waste Management, Inc. employee obtains the sample on your site, one of your employees must be present to direct our employee to the sample source and to witness the sampling. Your employee must also provide the information requested in this PART D.

1. WITNESS' SIGNATURE - Sign in the space provided.
2. WITNESS' NAME - Print the name of the person who witnessed the sampling.
3. WITNESS' TITLE - Enter the witness' title.
4. WITNESS' EMPLOYER - Enter the witness' employer's name.
5. DATE - Enter the date the sampling event was witnessed.



DATE: January 29, 1988

Generator Address: Exide Corporation (Selma Closure)
P.O. Box 14205
Reading, PA 19612-4205

Company Contact: Jeff Leed

Project Number: 247-88-01-101

IIR Lab Number: 8-1031

Date Project Received: January 19, 1988

Date Analysis Completed: January 29, 1988

Client Sample No.

1

Laboratory No.

8-1031

Sample Description

Waste Pile

Approved by: Michael D. [Signature]

Date: 1/29/88

Analytical Results:

Laboratory Sample No.: 8-1031

<u>Analyte</u>	<u>Result</u>
pH	6.9
Total lead	39,800 mg/Kg

EP Toxicity:

<u>Analyte</u>	<u>EP Maximum Concentration</u>	<u>Sample 8-1031</u>
Arsenic (mg/l)	5.0	.030
Barium (mg/l)	100.0	<1.0
Cadmium (mg/l)	1.0	<.05
Chromium (mg/l)	5.0	<.05
Lead (mg/l)	5.0	5.9
Mercury (mg/l)	.2	<.001
Selenium (mg/l)	1.0	.010
Silver (mg/l)	5.0	<.05

Approved by: Michael A. Long
Date: 10/1/88

ORDERING DEPT. Env. Resources	EXT. 852	ISSUED BY J. A. Leed	DATE 3/11/88	APPROVED BY <i>Jeffrey D. Leed</i>	DATE 3/14/88
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GENERAL BATTERY CORPORATION

P.O. BOX 1262 • READING, PENNSYLVANIA 19603
Phone: (215) 378-0800

PURCHASE ORDER

SHOW THE P.O. NUMBER (INCLUDING ALPHA PREFIX) ON ALL SHIPPING CONTAINERS, PACKING LISTS & INVOICES

CONFIRMING TELEPHONE (3/11/88)	ACCOUNT CLASSIFICATION	ORDER DATE 3/11/88	PURCHASE ORDER NO. ER 515945	PAGE OF 1/1
ON D. Roberts WITH R. Sanders, WHO Mfg. 4410-801-A				
SHIP VIA	P.O.B.	TERMS Net 40 days	SHIP TO	16

V
E
N
D
O
R

Chemical Waste Management, Inc.
ATTN: Ms. Debbie Roberts
2600 Delk Road
Suite 100
Marietta, Georgia 30067

1. RA Spring Valley Road and Nolan St., Reading, Pa. 19605
2. RI Montrose Ave. and Angeline St., Laureldale, Pa. 19605
3. HP 250 Grand St., Hamburg, Pa. 19526
4. GS Old Chick Springs Rd., Greer, S. C. 29615
5. FI 555 Hoke Ave., Frankfort, Ind. 46061
6. RD Muhlenberg Industrial Park-East, Rt. 61, Portville Pike, Reading, Pa. 19605
7. DT 2040 Motor St., Dallas, Texas 75235
8. CC 13110 Loudon Lane, City of Industry, Calif. 91744
9. PP 4949 25th Ave., S.E., Portland, Ore. 97202
10. AD 430 N. Second St., Reading, Pa. 19601
11. SK Berg Road, S. Industrial Park, Salina, Kansas 67401
12. LP 825 Paramount Avenue, Lancaster, Pa. 17637
13. QA Muhlenberg Industrial Mall-West, 6440 Portville Pike, Reading, Pa. 19605
14. MM R.R. #1, Grant St., Manchester, Iowa 52057
15. TL 3026 Summit St., Toledo, Ohio 43611
16. 845 Penn Street, Reading, Pa. 19601
17. Other See Below

ITEM NO	QUANTITY ORDERED	QUANTITY RECEIVED	UNIT	DESCRIPTION	TC	PART NUMBER	UNIT PRICE
1				CONFIRMED ORDER - DO NOT DUPLICATE	79		
2					79		
3				Costs for transportation and disposal	79		
4				of soil/debris from Exide Corporation	79		
5				Selma, Alabama at the Chemical Waste	79		
6				Management Landfill in Emelle, Alabama	79		
7				Estimated costs for transport and	79		
8				disposal.	79		\$ 1600.00
9					79		
10				Constituents of waste as described	79		
11				on Generator's Waste Material Profile	79		
12				Sheet MAR-H-17357. Scheduling to be	79		
13				arranged through Rod Sanders, WHO	79		
14				Mfg., Selma, Alabama.	79		
15					79		

THIS ORDER SUBJECT TO GBC ADDITIONAL TERMS	YES <input type="checkbox"/>	NO <input type="checkbox"/>
THIS ORDER SUBJECT TO PENNSYLVANIA SALES AND USE TAX	YES <input type="checkbox"/>	NO <input type="checkbox"/> TAX EXEMPTION
THIS ORDER SUBJECT TO Alabama SALES AND USE TAX	YES <input type="checkbox"/>	NO <input checked="" type="checkbox"/> NO. 68-1991
DELIVERY AT OUR PLANT	Invoice to: Exide Corporation ATTN: Accounts Payable P. O. Box 14205 Reading, PA 19612-4205	
REMARKS	PURCHASING AGENT	

SUBMIT ONLY ORIGINAL INVOICE. DO NOT CONSOLIDATE BILLINGS. MAIL ORIGINAL INVOICE TO: GENERAL BATTERY CORPORATION, ACCOUNTS PAYABLE DEPARTMENT, P.O. BOX 1262, READING, PA. 19603
SHOW PURCHASE ORDER NUMBER (INCLUDING ALPHA PREFIX) ON ALL SHIPPING CONTAINERS, PACKING LISTS AND INVOICES. CONSIGN ALL SHIPMENTS TO OUR RECEIVING DEPARTMENT, UNLESS OTHERWISE INDICATED, SHIP CHEAPEST WAY. CERTIFICATE OF INSURANCE TO BE SUBMITTED TO CORPORATE PURCHASING PRIOR TO PERFORMING WORK ON OUR PROPERTY.

ACKNOWLEDGMENT OF THIS ORDER CONSTITUTES YOUR AGREEMENT TO MAINTAIN THE ABOVE PRICE FOR THE QUANTITIES INDICATED.

THIS ORDER SUBJECT TO TERMS AND CONDITIONS ON REVERSE SIDE.

PRINTED BY GBC

ORIGINAL

ORDERING DEPT. Env. Resources	EXT. 852	ISSUED BY J. A. Leed	DATE 3/14/88	APPROVED BY <i>Jeffrey A. Leed</i>	DATE 3/15/88
----------------------------------	-------------	-------------------------	-----------------	---------------------------------------	-----------------



GENERAL BATTERY CORPORATION

P.O. BOX 1262 • READING, PENNSYLVANIA 19603
Phone: (215) 376-0800

PURCHASE ORDER

SHOW THIS P.O. NUMBER ON
CLUDING ALPHA PREFIX ON
ALL SHIPPING CONTAINERS
PACKING LISTS & INVOICES

CONFIRMING TELEPHONE ON 3/14/88 WITH Rod Sanders	ACCOUNT CLASSIFICATION 4410-801-A	ORDER DATE 3/14/88	PURCHASE ORDER NO. ER 515927	PAGE OF 1 1
SHIP VIA -	F.O.B. -	TERMS Net 40 days	SHIP TO ▶	16

V
E
N
D
O
R

WHO Manufacturing
Route 6, Box 343
Selma, Alabama 36701

1. RA Spring Valley Road and Nolan St., Reading, Pa. 19605
2. RI Montrose Ave. and Angelina St., Laureldale, Pa. 19605
3. HP 280 Grand St., Hamburg, Pa. 19626
4. GS Old Chick Springs Rd., Greer, S. C. 29615
5. FI 955 Hoke Ave., Frankfort, Ind. 46041
6. RD Muhlenberg Industrial Park-East, Rt. 61, Portville Pike, Reading, Pa. 19605
7. DT 2040 Motor St., Dallas, Texas 75235
8. CC 13110 Loudon Lane, City of Industry, Calif. 91744
9. PP 4946 25th Ave., S.E., Portland, Ore. 97202
10. AD 430 N. Second St., Reading, Pa. 19601
11. SK Berg Road, S. Industrial Park, Salina, Kansas 67401
12. LP 829 Paramount Avenue, Lampeter, Pa. 17537
13. QA Muhlenberg Industrial Mill-West, 4440 Portville Pike, Reading, Pa. 19605
14. MH R.R. # 1, Grant St., Manchester, Iowa 52057
15. TL 3028 Summit St., Toledo, Ohio 43611
16. 648 Penn Street, Reading, Pa. 19601
17. Other See Below

ITEM NO	QUANTITY ORDERED	QUANTITY RECEIVED	UNIT	DESCRIPTION	TC	PART NUMBER	UNIT PRICE
1				CONFIRMED ORDER - DO NOT DUPLICATE	79		
2					79		
3				Labor for loading of soil at Exide/	79		
4				GBC facility, Selma, Alabama for	79		
5				subsequent shipment to Chemical Waste	79		
6				Management, Emelle, Alabama for	79		
7				disposal. Cost includes administrative	79		
8				requirements associated with shipment	79		
9				of material.	79		\$ 400.00
10					79		
11					79		
12					79		
13					79		
14					79		
15					79		

THIS ORDER SUBJECT TO GBC ADDITIONAL TERMS	YES <input type="checkbox"/>	NO <input type="checkbox"/>	
THIS ORDER SUBJECT TO PENNSYLVANIA SALES AND USE TAX	YES <input type="checkbox"/>	NO <input type="checkbox"/>	TAX EXEMPTION
THIS ORDER SUBJECT TO Alabama SALES AND USE TAX	YES <input type="checkbox"/>	NO <input checked="" type="checkbox"/>	NO. 68-1991

DELIVERY AT OUR PLANT	
REMARKS Selma Closure	PURCHASING AGENT

SUBMIT ONLY ORIGINAL INVOICE. DO NOT CONSOLIDATE BILLINGS. MAIL ORIGINAL INVOICE TO: GENERAL BATTERY CORPORATION, ACCOUNTS PAYABLE DEPARTMENT, P.O. BOX 1262, READING, PA. 19603
SHOW PURCHASE ORDER NUMBER (INCLUDING ALPHA PREFIX) ON ALL SHIPPING CONTAINERS, PACKING LISTS AND INVOICES. CONSIGN ALL SHIPMENTS TO OUR RECEIVING DEPARTMENT. UNLESS OTHERWISE INDICATED, SHIP CHEAPEST WAY. CERTIFICATE OF INSURANCE TO BE SUBMITTED TO CORPORATE PURCHASING PRIOR TO PERFORMING WORK ON OUR PROPERTY.

ACKNOWLEDGMENT OF THIS ORDER CONSTITUTES YOUR AGREEMENT TO MAINTAIN THE ABOVE PRICE FOR THE QUANTITIES INDICATED.
THIS ORDER SUBJECT TO TERMS AND CONDITIONS ON REVERSE SIDE.

APPENDIX 7

CHAIN OF CUSTODY RECORD

CHAIN OF CUSTODY RECORD

				SAMPLERS (signature)					
STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE		SEC. NO.	NO. OF CON- TAINERS	ANALYSIS REQUIRED	
				WATER comp	AIR grab				
RELINQUISHED BY: (signature)				RECEIVED BY: (signature)				DATE/TIME	
RELINQUISHED BY: (signature)				RECEIVED BY: (signature)				DATE/TIME	
RELINQUISHED BY: (signature)				RECEIVED BY: (signature)				DATE/TIME	
DISPATCHED BY: (signature)			DATE/TIME	RECEIVED FOR LABORATORY BY:				DATE/TIME	

PLOT PLAN SET A

SITE MAPS SHOWING LEAD IN SOIL CONCENTRATIONS
FROM CH2M-HILL FIELD INVESTIGATION REPORT



CLERM
HILL

DATE
BY

NO. DATE

REVISION

DATE

BY

DATE

BY

DATE

BY

DATE

BY

DATE

BY

DATE

BY

DATE

BY

DATE

TOTAL AND EP LEAD RESULTS
OF 0"-3" SOIL SAMPLES
GENERAL BATTERY CORPORATION
SELMA, AL PLANT



CEMA
III

SCALE

TOTAL AND EP LEAD RESULTS
OF SEDIMENT SAMPLES
GENERAL BATTERY CORPORATION -
SELMA, AL. PLANT

PLOT PLAN SET B

SITE MAPS SHOWING SCOPE OF REMEDIAL ACTIONS
AND APPROXIMATE LOCATIONS AT WHICH SOIL
SAMPLES WILL BE COLLECTED TO VERIFY
ADEQUATE DECONTAMINATION



NO.	DATE	REVISION

REUSE OF DOCUMENTS
 THIS DOCUMENT AND THE IDEAS AND DESIGNS HEREIN
 INCORPORATED HEREIN AS AN INSTRUMENT OF PROFESSIONAL
 SERVICE IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE
 REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY
 MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING,
 RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL
 SYSTEM, WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.

BAR IS ONE INCH ON
 ORIGINAL DRAWING
 NOT ONE INCH ON
 THIS SHEET. ADJUST
 READER'S EYE TO VIEW.

SCALE
 1" = 50'

0 - DENOTES SOIL SAMPLE LOCATION

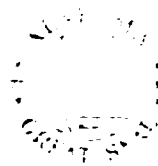
EXIDE CORPORATION
 SELMA, AL
 SCOPE OF REMEDIAL WORK

DATE	3/23/88
PROJECT NO.	J LEBB

PRELIMINARY

ADEM

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT



Guy Hunt
Governor

High Piques, Director

751 Federal Drive
Montgomery, AL
36130
205/271-7700

May 26, 1988

Mr. Jeffrey A. Leed, Director
Waste Management
Exide Corporation
P. O. Box 14205
Reading, Pennsylvania 19612-4205

Field Offices:

Unit 806, Building 8
25 Oxmoor Circle
Birmingham, AL
35209
205/942-6168

Dear Mr. Leed:

Re: Exide/General Battery Corporation, Selma, Alabama

P.O. Box 953
Decatur, AL
36002
205/353-1713

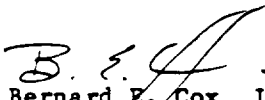
We have reviewed your April 4, 1988 proposal for remediation of contaminated soils at Exide/General Battery Corporation's Selma, Alabama facility. The plan describes an acceptable procedure for managing lead-contaminated soils at this site.

204 Perimeter Road
Mobile, AL
36616
205/479-2336

As you know, the State of Alabama has no regulations which address remediation activities at sites which are not regulated under the Alabama Hazardous Waste Management and Minimization Act. Therefore, our acceptance of this plan does not absolve Exide/General Battery from its responsibility under Federal "Superfund" statutes.

Mr. William Turk of the Hazardous Waste Branch, Compliance Section, will be your contact during project implementation. Please contact Mr. Turk or Ms. Margaret Corey, at 205-271-7737, should you have further questions regarding this matter.

Sincerely,


Bernard E. Cox, Jr., Chief
Hazardous Waste Branch
Land Division

BEC/MMC/bw

General Battery Corporation
RECEIVED
JUN 3 1988
Environmental Resources
Reading, Pa.

April 18, 1990

Mr. William Turk
Hazardous Waste Branch, Compliance Section
Alabama Department of Environmental Management
1751 Federal Drive
Montgomery, AL 36130

RE: Exide/General Battery Corporation; Selma, Alabama
Final Report of 1989 Soil Clean-up/Remedial Activities

Dear Mr. Turk:

Enclosed for your information and files are two copies of the final report of the 1989 soil clean-up project which was undertaken at the Exide/General Battery Corporation facility in Selma, Alabama.

Should additional information be required, please contact this office at (215) 378-0852.

Very truly yours,

EXIDE CORPORATION

A handwritten signature in dark ink, appearing to read "Jeffrey A. Leed", followed by a small mark that looks like "1/26".

Jeffrey A. Leed
Director - Waste Management

JAL:sb

EXIDE/GENERAL BATTERY CORPORATION
SELMA, ALABAMA

REPORT OF 1989
SOIL CLEAN-UP/REMEDIAL ACTIVITIES

Exide Corporation
Department of Environmental Resources
P. O. Box 14205
Reading, Pennsylvania 19612-4205

April 1990

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1.0 INTRODUCTION

Exide Corporation is submitting this report to the Alabama Department of Environmental Management (ADEM) to document the remedial activities which were undertaken at the Exide/General Battery Corporation facility located along the Old Montgomery Highway, Selma, Alabama during the September - October 1989 period.

The soil clean-up/remedial activities were outlined in the Closure Plan for Remediation of Lead-Containing Soil, submitted to ADEM by Exide/General Battery Corporation in April 1988 and accepted by ADEM by letter dated May 26, 1988 from Mr. Bernard E. Cox, Jr., Chief, ADEM Hazardous Waste Branch, Land Division.

2.0 BACKGROUND INFORMATION

In February 1987, General Battery Corporation submitted two copies of the Field Investigation Report for the inactive Selma, Alabama plantsite (prepared by CH2M-Hill) to the Alabama Department of Environmental Management for review. The Field Investigation Report presented data from the analyses of 132 soil samples (66 collected at a depth of 0 (surface) to 3 inches below the surface, and 66 collected at a depth of 3 to 6 inches below the surface), 30 stream sediment samples, 32 soil boring samples, and 22 groundwater samples which were collected by CH2M-Hill during July-August 1986.

Data from the Field Investigation Report were reviewed during a meeting held in the ADEM offices in Montgomery, Alabama on April 1, 1987. Representatives at the meeting included the Alabama Department of Environmental Management, General Battery Corporation, and CH2M-Hill.

To verify reported lead in soil concentrations and to address several inconsistencies in the data, CH2M-Hill was subsequently authorized by General Battery Corporation at the April 1, 1987 meeting to resample soil at several sampling sites. The scope of the additional work was later revised to include resampling/reanalysis of soil at additional sites. The resampling/reanalysis program was also subsequently expanded by Exide Corporation to include confirmatory soil testing at four laboratories including CH2M-Hill (Montgomery, Alabama), Talbot Laboratories (Valley Forge, Pennsylvania), Lancaster Laboratories (Lancaster, Pennsylvania), and M.J. Reider Associates, Inc. (Reading, Pennsylvania).

Correspondence which described the resampling/reanalysis program was provided to the Alabama Department of Environmental Management on August 11, 1987. Data from the CH2M-Hill Field Investigation Report were shown, by sampling location, on the aerial photograph reproductions which were appended to the Exide Corporation Closure Plan for Remediation of Lead-Containing Soil, submitted to ADEM in April 1988.

3.0 REVIEW OF SOIL CLEAN-UP ACTIVITIES PRIOR TO 1989

In August 1987, WHO Manufacturing (Selma, Alabama) initiated work at the Exide Corporation facility in Selma which included the sandblasting of outer walls and three concrete pads located along the west side of the building. In conjunction with this work, WHO Manufacturing was also authorized by Exide Corporation to excavate the soil immediately adjacent to the pads and to collect soil samples during and after the excavation. Detailed information related to the excavation and soil sampling was included in the Closure Plan for Remediation of Lead-Containing Soil, submitted to ADEM by Exide Corporation in April 1988.

Upon attainment of acceptable lead in soil concentrations in the excavated area, WHO Manufacturing was subsequently authorized to backfill the area with sand and stone. A composite sample of excavated soil was subsequently collected and submitted for analysis by Industrial Resource Development Company (IRD), Norristown, Pennsylvania. Data from the IRD analysis of the composite sample was subsequently included with Exide Corporation's request for disposal authorization of this material at the Chemical Waste Management landfill in Emelle, Alabama. Authorization for disposal of the material was received from Chemical Waste Management by telephone by WHO Manufacturing, acting on behalf of Exide Corporation, on March 11, 1988. A contract with Chemical Waste Management was signed by Exide Corporation on March 22, 1988 and removal of one load of material (25,790 pounds) occurred on April 7, 1988. A copy of the Alabama Hazardous Waste Manifest which accompanied this shipment is provided in Appendix 1.

4.0 SUMMARY OF 1989 SOIL CLEAN-UP ACTIVITIES

4.1 Overview of Remedial Activities

Exide Corporation contracted with WHO Manufacturing (Selma, Alabama) to perform soil clean-up and related remedial activities at the site in 1989. Work at the site began in early September 1989 and off-site transport of soil continued until shipment of the final loads on October 30, 1989.

Exide Corporation also contracted with Chemical Waste Management, Inc. (U.S. EPA Identification Number ILD099202681) for transport of lead containing soil and subsequent disposal of the soil at Chemical Waste Management Inc.'s landfill (U.S. EPA Identification Number ALD000622464) in Emelle, Alabama.

During the period from September through October 1989, 34 truckloads (approximately 864.85 tons) of lead-containing soil were transported from the Exide/General Battery Corporation facility to the Chemical Waste Management disposal facility.

Soil conditioning was conducted at selected locations using the procedure outlined in the March 1988 Closure Plan for Remediation of Lead-Containing Soil.

4.2 Documentation of Shipments

Photocopies of Alabama Hazardous Waste Manifests which accompanied the shipments of soil to the Chemical Waste Management disposal facility during the September - October 1989 period are provided in Appendix 2. Copies of other information and correspondence from Chemical Waste Management, which acknowledged the receipt of waste shipments are also provided in Appendix 2.

A summary log for the shipments, prepared by WHO Manufacturing, is provided in Appendix 3.

4.2 Soil Sampling and Verification of Soil Clean-up Activities

As outlined in the March 1988 Closure Plan for Remediation of Lead-Containing Soil, WHO Manufacturing personnel collected soil samples from locations throughout the site as excavation proceeded to verify adequate decontamination. Samples of soil were collected throughout the project as contaminated soils were excavated. Following excavation and in the event that the initial soil sampling did not demonstrate the attainment of acceptable soil decontamination criteria, WHO Manufacturing was instructed to excavate additional contaminated soil. The excavation/sampling sequence was repeated until acceptable decontamination criteria had been attained.

4.2 (Continued)

Exide Corporation contracted with M.J. Reider Associates, Inc. (Reading, Pennsylvania) to perform laboratory analysis of soil samples submitted by WHO Manufacturing. Samples were analyzed for total lead and extractable lead using the EP toxicity test.

A drawing of the facility which has been prepared to show the final soil sampling locations at the conclusion of the project is provided in Appendix 4.

Analytical data from the testing of soil samples are provided in Appendix 5. The data included in Appendix 5 represent all of the test results which were obtained during completion of the 1989 soil clean-up project. This information includes the results of samples which were collected prior to demonstration of adequate decontamination. The data which represent the final site conditions, following removal of overlying contaminated soil, are clearly identified on the laboratory reports and are also summarized in Table 1.

4.4 Placement of Backfill into Excavated Areas

Following attainment of adequate decontamination as verified by soil sampling results, WHO Manufacturing was authorized to proceed with the placement of backfill in excavated areas. The soil used for backfill was obtained from an off-site source and was tested for lead content prior to use.

Analytical data from the testing of two samples of backfill soil is provided on the M.J. Reider analytical report dated September 15, 1989 (copy provided in Appendix 5). As indicated on the laboratory report, backfill soil sample A contained a total lead (dry weight) concentration of 23.6 mg/kg and an EP toxicity concentration of less than 0.048 mg Pb/l, while backfill soil sample B contained a total lead (dry weight) concentration of 3.51 mg/kg and an EP toxicity concentration of 0.048 mg Pb/l.

Backfilled areas have been reseeded and revegetated.

5.0 DECONTAMINATION RESULTS

5.1 Decontamination Objectives

As outlined in the March 1988 Closure Plan for Remediation of Lead-Containing Soil, Exide Corporation's implementation of the plan was undertaken to achieve the following remedial objectives:

1. To excavate contaminated soil (which exceeds an E.P. toxicity concentration of 5.0 mg Pb/l),
2. For lesser contaminated soil (e.g., where E.P. toxicity concentrations are less than 5.0 mg Pb/l), to condition the soil with underlying soil, and
3. Upon completion of item 1 and 2 above, to sample and analyze the soil (for total lead and E.P. toxicity for lead) in the areas where remedial measures were implemented to verify the success of remedial efforts.

5.2 Summary of Decontamination Results

Based upon the data provided in Appendices 4 and 5 and the final site conditions summarized in Table 1 on the following pages, it is Exide Corporation's belief that the remedial objectives have been achieved. The results of soil sampling, conducted following excavation of overlying contaminated soil, indicate that total lead (dry weight) concentrations of less than 450 mg Pb/kg have been achieved at all sampling locations.

At the conclusion of remedial activities, EP toxicity levels of 1.71 and 1.44 mg Pb/l had been obtained at sampling sites 13 and X-7, respectively, while concentrations were less than 0.444 mg Pb/l at all other sampling sites.

A summary of the final soil sampling results is provided in Table 1.

TABLE 1
EXIDE/GENERAL BATTERY CORPORATION
SUMMARY OF FINAL DATA

SAMPLE SITE NUMBER	FINAL SAMPLE ID *	DEPTH (IN INCHES) EXCAVATED BELOW SURFACE	SOIL REMAINING IN PLACE FOLLOWING EXCAVATION OF OVERLYING CONTAMINATED SOIL	
			TOTAL LEAD (mg/kg)	EP TOXICITY LEAD (mg/l)
-	Clean Back- fill A	-	23.6	LT 0.048
-	Clean Back- fill B	-	3.51	0.048
1	1-3	Conditioned	438 427 (Duplicate)	0.143 0.143 (Duplicate)
2	2-3	Conditioned	126	0.143
3	3-A-4	Conditioned	127	LT 0.004
4	4-3	Conditioned	71.6	0.048
5	5-A-6	Conditioned	4.51	0.051 0.051 (Duplicate)
6	6-A-6	Conditioned	136	0.042
7	7-3	Conditioned	66.5	0.048
8	8-A-4	Conditioned	22.1	LT 0.004
9	9-A-5	Conditioned	107	0.032 0.016 (Duplicate)
10	10-A-4	Conditioned	29.4	LT 0.004
11	11-A-4	4	5.65	LT 0.004
12	12-A-12	12	6.31	LT 0.004
13	13-3	3	283	1.71
14	14-A-6	6	3.85	LT 0.005
	14-B-8	8	2.43	0.046
15	15-A-14	14	1.29	LT 0.004
16	16-A-10	10	34.7	LT 0.004
17	17-3	3	64.9	0.381
18	18-3	3	157	0.190

LT = Less Than

* = Final number in sample identification indicates depth at which soil sample was collected (i.e., for sample 1-3, the sample was collected at 3 inches below the surface).

TABLE 1 (Continued)

SAMPLE SITE NUMBER	FINAL SAMPLE ID *	DEPTH (IN INCHES) EXCAVATED BELOW SURFACE	SOIL REMAINING IN PLACE FOLLOWING EXCAVATION OF OVERLYING CONTAMINATED SOIL	
			TOTAL LEAD (mg/kg)	EP TOXICITY LEAD (mg/l)
19	19-A-12	12	11.7	0.005
	19-B-12	12	34.5	0.028
	19-C-16	16	167	0.036
20	20-3	3	4.72	LT 0.004
X-1	X-1-3	3	200	-
			175 (Duplicate)	
X-2	X-2-10	10	3.25	LT 0.005
X-3	X-3-3	3	395	-
X-4	X-4-3	3	439	-
X-5	X-5-A-8	8	69.2	0.009
X-6	X-6-A-8	8	71.7	0.005
X-7	X-7-12	12	213	1.44
X-8	X-8-12	12	410	0.162
A	A-6	6	8.46	LT 0.004
B	B-6	6	6.24	LT 0.004
G	G-3	3	41.0	0.005
H	H-3	3	205	0.444
I	I-A-6	6	424	0.008
K	K-A-48	48	53.3	LT 0.004

LT = Less Than

* = Final number in sample identification indicates depth at which soil sample was collected (i.e., for sample 1-3, the sample was collected at 3 inches below the surface).

APPENDIX 1

HAZARDOUS WASTE MANIFEST FOR APRIL 7, 1988 SHIPMENT
TO CHEMICAL WASTE MANAGEMENT, INC.



HAZARDOUS WASTE MANIFEST

(As Required By The Alabama Department of Environmental Management)

Please print or type. (Form designed for use on elite (12-pitch) typewriter.)

Form Approved. OMB No. 2060-0038. Expires 9-30-88

UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator's US EPA ID No. AL10103411040451	Manifest Document No.	2. Page 1 of 1	Information in the shaded areas is not required by Federal law.
3. Generator's Name and Mailing Address ENIDE/GENERAL BATTERY CORPORATION Attn: Accounts Payable Dept. Box 14205, Reading, Pa. 19612-4205					
4. Generator's Phone Ph: 215-378-0500					
5. Transporter 1 Company Name CHEMICAL WASTE MANAGEMENT, INC.		6. US EPA ID Number AL10103411040451			
7. Transporter 2 Company Name		8. US EPA ID Number			
9. Designated Facility Name and Site Address CHEMICAL WASTE MANAGEMENT, INC. Emelle Facility Alabama Highway 17 at Mile Marker 163 Emelle, Alabama 35459		10. US EPA ID Number AL10103411040451			
11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number) a. <u>RU, hazardous waste, Solids, NQS (Lead)</u> <u>UM-1, NA9109</u> CWM Profile Number <u>3AR 317357</u>		12. Containers No. Type		13. Total Quantity	14. Unit Wt/Vol
b. CWM Profile Number					
c. CWM Profile Number					
d. CWM Profile Number					
15. Special Handling Instructions and Additional Information <u>handle to minimize airborne suspension of dust.</u>					
16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations. If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment. OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.					
Printed/Typed Name <u>Don Sanders</u>		Signature _____ Month Day Year ____/____/____			
17. Transporter 1 Acknowledgement of Receipt of Materials Printed/Typed Name <u>Don Sanders</u>		Signature _____ Month Day Year ____/____/____			
18. Transporter 2 Acknowledgement of Receipt of Materials Printed/Typed Name		Signature _____ Month Day Year ____/____/____			
19. Discrepancy Indication Space					
20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in item 19. Printed/Typed Name _____ Signature _____ Month Day Year ____/____/____					

APPENDIX 3

SUMMARY LOG FOR SEPTEMBER - OCTOBER 1989 SHIPMENTS
TO CHEMICAL WASTE MANAGEMENT, INC.

HAZARDOUS WASTE MANIFEST LOG- SOIL CLEAN-UP, EXIDE CORP., SELMA, AL.Generator: Exide Corporation, P.O. Box 14205, Reading, Pa. 19612-4205Transporter: Chemical Waste Management, Inc., Emelle, AlabamaContractor: Who Manufacturing, Rt. 6 Box 378-B, Selma, Al. 35601

DATE	GENERATOR MANIFEST DOCUMENT #	STATE MANIFEST DOCUMENT #	PROFILE #	GROSS WGT. POUNDS	NET WGT. POUNDS	TOTAL NET WEIGHT POUNDS
09-13-89	00000	147570	MAR H17357	76,320	45,000	45,000
09-15-89	00001	517100		84,200	50,900	95,900
	00002	517082		85,660	52,940	148,840
	00003	517099		89,470	58,610	207,450
	00004	517083		85,280	52,880	260,330
	00005	517085		80,320	47,900	308,230
09-19-89	00006	517086		83,260	50,900	359,130
	00007	401433		79,550	47,550	406,680
	00008	147571		81,140	49,140	455,820
	00009	147575		71,140	39,120	494,940
	00010	147573		76,040	44,040	538,980
	00011	147572		74,030	42,030	581,010
09-20-89	00012	517090		95,170	62,770	643,780
	00013	517088		87,630	56,630	700,410
	00014	517089		83,610	51,610	752,020
09-28-89	00015	517092		83,770	51,270	803,290
	00016	517091		93,920	61,420	864,710
	00017	517093		79,440	46,940	911,650
09-29-89	00018	517095		70,200	41,200	952,850
	00019	517094		77,830	46,830	999,680
	00020	517097		81,930	50,930	1,050,610
	00021	50312		79,490	46,290	1,096,900
	00022	517096		85,770	50,370	1,147,270
	00023	503106		76,430	43,930	1,191,200
10-30-89	00024	517223		85,310	52,110	1,243,310
	00025	517222		89,030	56,230	1,299,540
	00026	517221		89,640	56,440	1,355,980

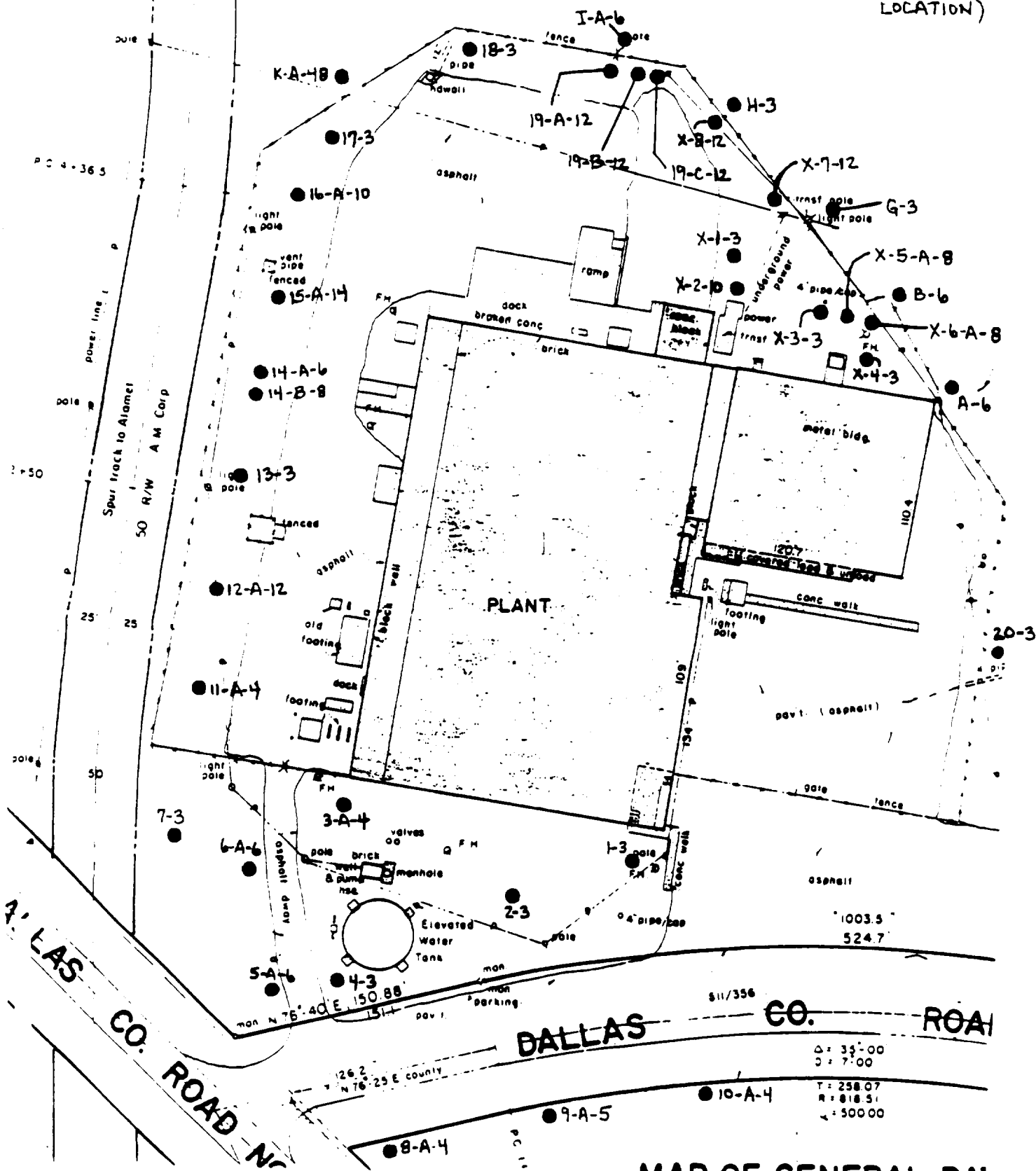
Contractor: Who Manufacturing, Rt. 6 Box 378-B, Selma, Al. 35601

[illegible]

APPENDIX 4

PLOT PLAN OF EXIDE/GBC FACILITY
LOCATIONS/IDENTIFICATIONS OF FINAL SOIL SAMPLING SITES

KEY = ● (SAMPLING LOCATION)



MAJOR GENERAL DA'

APPENDIX 5

ANALYTICAL DATA FROM TESTING OF SOIL SAMPLES

NOTE: Data included in Appendix 5 represent all of the test results which were obtained during completion of the 1989 soil clean-up project. The Appendix 5 information, therefore, includes the results of samples which were collected prior to demonstration of adequate decontamination. The data which represent the final site conditions, following removal of overlying contaminated soil, are also identified on the laboratory reports and are summarized in Table 1.



September 15, 1989

ANALYSIS OF SAMPLES SUBMITTED - SEPTEMBER 12, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Soil Samples (21)
9/11/89

	<u>Moisture (%)</u>	<u>Total Lead (mg/kg) (Dry Wt. Basis)</u>	<u>E.P. Toxicity Lead, mg/l</u>
Clean Fill A	8.85	23.6	< 0.048 — FINAL
Clean Fill B	1.48	3.51	0.048 — FINAL
1-3	1.13	438.	0.143 — FINAL
2-3	1.44	126.	0.143 — FINAL
3-3	.84	588.	0.190
4-3	2.63	71.6	0.048 — FINAL
5-3	4.61	1,466.	0.667
6-3	1.56	7,784.	4.95
7-3	2.66	66.5	0.048 — FINAL
8-3	1.08	2,016.	1.38
9-3	1.71	1,672.	1.43
10-3	2.31	723.	0.571
11-3	2.80	952.	0.857
12-3	1.89	5,729.	34.5
13-3	2.01	283.	1.71 — FINAL
14-3	1.42	4,856.	16.7
15-3	1.62	507.	5.62
16-3	2.08	1,564.	11.9
17-3	4.67	64.9	0.381 — FINAL
18-3	5.18	157.	0.190 — FINAL
19-3	1.58	20,621.	24.4
1-3 (Duplicate)	1.23	427.	0.143 — FINAL
11-3 (Duplicate)	2.67	619.	0.333

< = less than
mg/l = milligram per liter
mg/kg = milligram per kilogram

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

ATTN: Jeff Leed

LAB WORK ORDER #53549
P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Technical Director



September 15, 1989

ANALYSIS OF SAMPLES SUBMITTED - SEPTEMBER 12, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Soil Samples (8)
9/11/89

	<u>Moisture (%)</u>	<u>Total Lead</u> (mg/kg) (Dry Wt. Basis)
X-1	1.50	200. - FINAL
X-2	2.22	843.
X-3	3.94	395. - FINAL
X-4	2.10	439. - FINAL
X-5	2.15	3,507.
X-6	1.73	1,023.
X-7	1.17	4,453.
X-8	11.69	211,008.
X-1 (Duplicate)	1.52	175. - FINAL

mg/kg = milligram per kilogram

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

ATTN: Jeff Leed

LAB WORK ORDER #53551

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Technical Director



September 27, 1989

ANALYSIS OF SAMPLES SUBMITTED - SEPTEMBER 20, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples (9)
9/19/89

	<u>Moisture (%)</u>	<u>Total Lead</u> (mg/kg) (Dry Wt. Basis)
5-A-6	4.1	4.51 — FINAL
6-A-6	5.9	136. — FINAL
12-A-6	1.9	544.
14-A-6	3.2	3.85 — FINAL
14-B-8	3.2	2.43 — FINAL
15-A-10	3.3	19.8
16-A-6	1.5	16,944.
X-5-A-8	2.9	69.2 — FINAL
X-6-A-8	2.2	71.7 — FINAL
15-A-10 (Duplicate)	3.4	3.62

mg/kg = milligram per kilogram

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205


ATTN: Jeff Leed

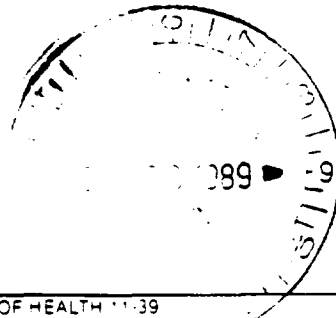
LAB WORK ORDER #53661

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.


Richard A. Wolfe
Technical Director





September 27, 1989

ANALYSIS OF SAMPLES SUBMITTED - SEPTEMBER 19, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples (13)
9/18/89

	<u>Moisture (%)</u>	<u>Total Lead</u> (mg/kg) (Dry Wt. Basis)
A-3	5.7	3,133.
G-3	1.4	41.0 — FINAL
H-3	11.5	205. — FINAL
I-3	3.9	1,587.
J-3	0.9	2,300.
K-3	4.7	134,472.
19-A-12	3.7	11.7 — FINAL
19-B-12	4.9	34.5 — FINAL
19-C-12	6.6	978.
X-8-12	3.7	410. — FINAL
X-7-12	9.0	213. — FINAL
X-2-10	3.4	3.25 — FINAL
B-3	9.9	2,898.
K-3 (Duplicate)	4.3	128,551.

mg/kg = milligram per kilogram

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

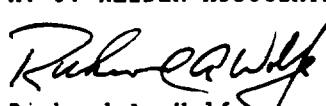
ATTN: Jeff Leed

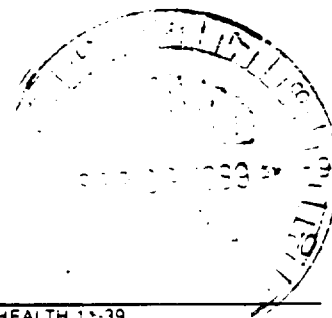
LAB WORK ORDER #53644

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.


Richard A. Wolfe
Technical Director



M. J. Reider Associates, Inc.
LICENSED ANALYTICAL LABORATORIES



CERTIFICATE OF ANALYSIS

M J REIDER LABORATORIES

PAGODA LABORATORY INC

NATIONAL STANDARDS TESTING LABORATORIES INC

October 5, 1989

ANALYSIS OF SAMPLES SUBMITTED - SEPTEMBER 27, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples

Lead, mg/l (E.P. Toxicity)

19-A-12	0.005 - FINAL
19-B-12	0.028 - FINAL
19-C-12	2.50
X-2-10	< 0.005 - FINAL
X-7-12	1.44 - FINAL
X-8-12	0.162 - FINAL
5-A-6	0.051 - FINAL
6-A-6	0.042 - FINAL
12-A-6	2.00
14-A-6	< 0.005 - FINAL
14-B-8	0.046 - FINAL
15-A-10	0.222
16-A-6	27.8
X-5-A-8	0.009 - FINAL
X-6-A-8	0.005 - FINAL
G-3	0.005 - FINAL
H-3	0.444 - FINAL
5-A-6 Duplicate	0.051 - FINAL

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

ATTN: Jeff Leed

LAB WORK ORDER #53751

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Technical Director



October 10, 1989

ANALYSIS OF SAMPLES SUBMITTED - OCTOBER 5, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples (6)
10/4/89

	<u>Moisture (%)</u>	<u>Total Lead (mg/kg) (Dry Wt. Basis)</u>	<u>E.P. Toxicity Lead, mg/l</u>
Pile No. 1	6.88	--	23.8
Pile No. 2	7.85	--	28.6
Pile No. 3	9.79	--	21.0
Pile No. 4	11.06	--	26.2
Pile A #1	8.06	19,283.	58.3
Pile A #2	5.88	27,182.	110.
Pile No. 1 Duplicate	6.36	--	31.0

mg/l = milligram per liter
mg/kg = milligram per kilogram

DATA REPRESENT SAMPLES
COLLECTED FROM A TEMPORARY
SOIL STOCKPILE GENERATED
DURING EXCAVATION OF AREAS J/K
TO A DEPTH OF 4 FEET BELOW
SURFACE. ALL MATERIAL WAS
DISPOSED OFF-SITE.

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

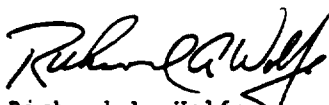
ATTN: Jeff Leed

LAB WORK ORDER #53826

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.


Richard A. Wolfe
Technical Director



October 10, 1989

ANALYSIS OF SAMPLES SUBMITTED - OCTOBER 3, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples (12)
10/2/89

	<u>Moisture (%)</u>	<u>Total Lead</u> (mg/kg) (Dry Wt. Basis)
3-A-4	8.76	127. - FINAL
8-A-4	11.0	22.1 - FINAL
9-A-5	8.06	107. - FINAL
10-A-4	7.60	29.4 - FINAL
11-A-4	7.63	5.65 - FINAL
12-A-10	5.58	1,148.
15-A-14	7.51	1.29 - FINAL
16-A-10	9.06	34.7 - FINAL
19-C-16	11.4	167. - FINAL
I-A-6	12.6	424. - FINAL
K-A-48	22.2	53.3 - FINAL
20-3	9.67	4.72 - FINAL
12-A-10 (duplicate)	5.37	984.

mg/kg = milligram per kilogram

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

ATTN: Jeff Leed

LAB WORK ORDER #53789

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Technical Director

M. J. Reider Associates, Inc.
LICENSED ANALYTICAL LABORATORIES



CERTIFICATE OF ANALYSIS

M. J. REIDER LABORATORIES

PAGODA LABORATORY, INC.

NATIONAL STANDARDS TESTING LABORATORIES, INC.

October 20, 1989

JAL 10/23/89

ANALYSIS OF SAMPLES SUBMITTED - OCTOBER 13, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples (3)
10/12/89

	<u>Moisture (%)</u>	<u>Total Lead (mg/kg) (Dry Wt. Basis)</u>	<u>Lead E.P. Toxicity (mg/l)</u>
A - 6	7.28	8.46	< 0.004 - FINAL
B - 6	7.05	6.24	< 0.004 - FINAL
12-A-12	7.15	6.31	< 0.004 - FINAL

< = less than
mg/kg = milligram per kilogram
mg/l = milligram per liter

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

ATTN: Jeff Leed

LAB WORK ORDER #53922

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Technical Director



October 20, 1989

ANALYSIS OF SAMPLES SUBMITTED - OCTOBER 3, 1989

Samples Submitted By: Exide Corporation/Who Manufacturing
Via: Federal Express

Sample Identification: Selma Alabama
Soil Samples

SUPPLEMENT TO LAB WORK ORDER #53789

E. P. Toxicity - Lead, mg/l

3-A-4	< 0.004 - FINAL
8-A-4	< 0.004 - FINAL
9-A-5	0.032 - FINAL
10-A-4	< 0.004 - FINAL
11-A-4	< 0.004 - FINAL
15-A-14	< 0.004 - FINAL
16-A-10	< 0.004 - FINAL
19-C-16	0.036 - FINAL
I-A-6	0.008 - FINAL
K-A-48	< 0.004 - FINAL
20-3	< 0.004 - FINAL
9-A-5 (Duplicate)	0.016 - FINAL

< = less than
mg/l = milligram per liter

Exide Corporation
P. O. Box 14205
Reading, PA 19612-4205

ATTN: Jeff Leed

LAB WORK ORDER #53997

P.O.#ER 516008

Respectfully submitted,

M. J. REIDER ASSOCIATES, INC.

Richard A. Wolfe
Technical Director

COBURN, CROFT & PUTZELL

ATTORNEYS AND COUNSELORS AT LAW

ONE MERCANTILE CENTER-SUITE 2900

AFFILIATED WITH
FORSYTH, SWALM & BRUGGER, PA.
600 FIFTH AVENUE, SUITE 210
NAPLES, FLORIDA 33940

ST. LOUIS, MISSOURI 63101
(314) 621-8575
TELECOPY (314) 621-2969

312 SOUTH ILLINOIS STREET
BELLEVILLE, ILLINOIS 62220-2183
(618) 277-1020

JOSEPH G. HASSIF

December 28, 1990

REPLY TO ST. LOUIS

Mr. Brad Bradley
United States Environmental
Protection Agency
230 South Dearborn Street (5HS-11)
Chicago, Illinois 60604

VIA FAX AND EXPRESS MAIL

To: NL Industries/Taracorp
Granite City Site -- Comments to
Administrative Order by AT&T

Dear Mr Bradley:

Since receiving notice in early December, 1989 from the USEPA, AT&T has actively participated in the work of the NL Industries/Taracorp site PRP Committee ("PRP Committee") with Johnson Controls, Incorporated ("Johnson Controls") and other alleged generators. AT&T has been a party to the PRP Committee's submissions to the EPA and incorporates all earlier submissions of the PRP Committee as part and parcel of the comments contained herein.

In response to paragraph 79 of the Order for Remedial Design and Remedial Action ("the Order") issued by the United States Environmental Protection Agency, AT&T expressly adopts and incorporates the sum and substance of the comments of December 20, 1990, to the Order submitted by Johnson Controls and the December 27, 1990, comments of Exide Corporation/General Battery Corporation.¹ AT&T believes that EPA's remedy as set forth in the record of decision is improper and was improperly selected.

¹ Specific comments on the shortcoming of the Order are also included in Attachment A.

Mr. Brad Bradley
December 28, 1990
Page Two

AT&T is especially concerned that EPA has been unwilling to gather or consider any site-specific data that would form a rational and empirical basis for a soil clean-up level. This shortcoming is not only significant for the reasons set forth in the comments of Johnson Controls and Exide, but it is also contrary to the published views of EPA research personnel.² In the attached article, Mr. Elias identifies the need to study each situation and base decisions on site specific conditions. In addition, he states that removal of heavily contaminated soil should only take place where it can be shown that the presence of lead is detrimental to human health. Not only has there been no site specific consideration of the various alternatives to soil replacement, including tilling, as discussed in Mr. Elias's article, but also, and more significantly, the EPA has no data demonstrating that lead in the soil in Granite City, or any other area for that matter, poses any significant risk of exposure to residents. As pointed out in documents previously submitted to the Agency, the studies that have been done to date suggest no such relationship exists.

AT&T is concerned that EPA has not to date expressed a clear willingness to consider the clean-up alternative of tilling and sodding raised by PRPs. It is likely that this remedy would be more quickly completed, safer, more permanent, and more cost effective than the remedy of excavation, concentration of residues and capping selected by EPA. During the meeting with Agency representatives on December 21, 1990, one of the representatives asked whether or not the State of Minnesota, which has adopted tilling as a cost effective alternative to soil replacement, had conducted any studies to prove the effectiveness of tilling. Although we are unaware of any testing performed by the State of Minnesota, we have been recently informed that the Office of Environmental Criteria and Assessment, USEPA, is involved in three lead abatement demonstration projects in Boston, Baltimore, and Cincinnati. In each instance the effectiveness of tilling is being evaluated. Tilling was also examined as a potential abatement method at a Toronto lead smelter site. The results of the three studies referenced above will be available later in 1991.

² See Attachment B "Soil-Lead Abatement Overview; Alternatives to Soil Replacement", Robert W. Elias, Environmental Criteria and Assessment Office, U.S. Environmental Protection Agency, Research Triangle Park.

Mr. Brad Bradley
December 28, 1990
Page Three

In Attachment C, a copy of the initial project summary for the Baltimore study is enclosed for your reference. As one can see, the Maryland Department of the Environment, Center for Environmental Health, recently completed a three-year project to test the effectiveness of various remedial measures to reduce lead contamination in soil in the prevention of lead poisoning. (See Attachment C). The project which was just completed within the last two months studied both tilling and excavation. The project was jointly sponsored with the U.S. Environmental Protection Agency. We have requested copies of the data obtained from the study, including cost figures for the various alternatives, which we expect to receive in the near future. We will forward this information to you upon receipt. This project looked specifically at the extent of soil/lead contamination and its relationship, if any, to childhood lead poisoning. Several aspects of the project are significant to the ROD and the Order.

The main hypothesis of the project was that a significant reduction (greater than 1000 ppm) of lead in soil accessible to children would not result in a significant decrease in blood lead levels. This hypothesis is consistent with the criticisms of the PRPs to the current agency analysis and conclusions as set forth in the ROD. Furthermore, after selecting a goal to reduce surface soil lead contamination in certain residential areas of Baltimore to a level not exceeding 500 ppm, tilling was the abatement method chosen for those areas with lead contamination under 1000 ppm and above 600 ppm. This is precisely the pilot project proposal made by the PRP's to the agency in this case. The adoption of this approach in Baltimore by the agency dramatically points out the deficiencies of the ROD and Order.

AT&T is distressed by EPA's improper refusal to consider the PRP's good faith offer to perform an environmental assessment of the Granite City area, of the sort performed in Baltimore, that would investigate the relationship between soil and blood lead levels on a site specific basis, and to perform a clean-up based on the results of that assessment.

AT&T believes that tilling and sodding is a remedy that is not only more effective than the remedy selected by EPA, but is a remedy that could lead to a settlement and an expedited

Mr. Brad Bradley
December 28, 1990
Page Four

clean-up. Following the meeting on December 21 with Agency representatives, AT&T now knows that tilling of soil has been explored as a lead abatement option in Baltimore, Boston, Cincinnati, Selma, Alabama, Minneapolis-St. Paul, and Toronto. Because of the interest expressed by Agency representatives for information pertaining to actual use of tilling as an abatement measure, we are in the process of seeking additional information regarding these events and will forward it to you as soon as it is received. It is particularly telling that Agency representatives acknowledged during the meeting on Friday that "At the FS stage, tilling is an alternative that will need to be considered in the future."

There are numerous and reasonable explanations as to why tilling was not considered in the FS prepared for this site. First of all, as discussed in great detail in earlier submissions to the EPA, the generator PRPs, including AT&T, were not notified of their PRP status until after the FS was completed and the Agency had already selected the remedy. NL Industry acknowledged at the meeting of December 21, 1990, that its FS failed to consider tilling because it did not deal with clean-up of residential soil with lead levels below 1000 ppm. In addition, the acceptance of tilling as a remedial alternative is a fairly recent event as is demonstrated by the fact that actual field experience with tilling is just now being evaluated. The fact that it was not thoroughly addressed prior to the issuance of the ROD is not the fault of the generator PRPs. Furthermore, since the remedial design has not yet been started, in light of the NCP guidelines and ongoing studies, it is unreasonable to proceed blindly with the remedy selected in the ROD and disregard a potential cost savings of \$20 million. AT&T urges EPA to work with the PRPs toward a solution for the site that will give fair consideration to the as yet undeveloped empirical data referenced above, and to appropriate alternative remedies that have not been adequately studied for this site.

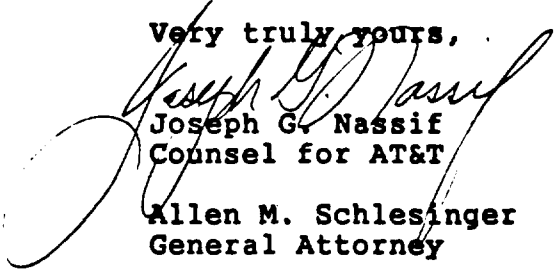
It makes absolutely no sense to go forward with a ROD which is defective on its face. To do so would only delay commencement of the clean-up and invite litigation.

Mr. Brad Bradley
December 28, 1990
Page Five

Following the meeting on December 21, 1990, there appears to be a consensus among all of the parties that if the Agency is willing to conduct a pilot study on tilling as part of the remedial design that the PRPs are willing to accept the clean-up levels set forth in the ROD. AT&T believes that this approach represents the only possible way to avoid litigation and further delay in the clean-up of the site. It is a course which the government has acknowledged should have been studied as part of the FS on this site. Under the circumstances set forth herein, and as more fully pointed out in the earlier submissions of the generator PRP Steering Committee, as well as the recent submissions of Johnson Controls and Exide, the Agency cannot rationally adopt litigation over the option proposed by the generator PRPs.

Finally, AT&T reserves the right to incorporate and adopt any and all other comments by any PRPs to the Order submitted to the Agency as part of this proceeding. The above comments represent the views of several PRPs and not just those of AT&T.

Very truly yours,



Joseph G. Nassif
Counsel for AT&T

Allen M. Schlesinger
General Attorney

cc: Mr. Alan Held
Mr. Steven Siegel

JGN:lmb
4981e

Attachment A

NL Industries/Taracorp Granite City Site

Additional AT&T Comments on Administrative Order

- 1) Order, p. 30, para. 38. Fifteen days is not enough time to retain a contractor to do the work under this order. The remediation contractor can't be hired until the remedial design is done. The time period here should be changed to allow for contractor selection following a reasonable period after completion and EPA acceptance of the remedial design.
- 2) Order p. 33, para. 44. The parties should be given a reasonable period, at a minimum, forty-five (45) days, after the effective date of the Order to name a project coordinator.

Attachment B

Soil Telling

and Hammond, P.B.
hand lead, and blood

and Blood Lead in
85-211. Agricultural

in inner city children:

face dust and soil: a

regulations: Synthetic
and Rule. Fed. Reg.

rd measurement and
surprise in Children.

Hammond, P.B. 1963.
dust and hand dust in

8. Modification of an
blood lead analysis.

Soil-lead Abatement Overview: Alternatives to Soil Replacement*

Robert W. Elms

Environmental Criteria and Assessment Office, US Environmental Protection Agency, Research Triangle Park, NC 27711, USA

Abstract

Soil lead abatement is the process of isolating lead contaminated soil from the human environment. In practice, the most common procedure has been the removal and replacement of lead contaminated soil. Because of control problems and costs, this may not be the most desirable approach, especially if alternatives are available. The alternatives discussed here (covering, washing and flushing) are potentially more effective and efficient, but each has some drawbacks. The advantages and disadvantages of soil abatement alternatives depend on the form of the lead in the soil, the nature of the soil column and the expected use of the restored land. It is likely that, when these alternatives have been tested, the selection of one alternative over another will be based on site specific conditions.

Introduction

The objective of a soil lead abatement programme is to isolate effectively the lead in soil from the human environment. One solution is to remove the soil and replace it with clean soil. Although continued efforts need to be made to reduce the expense and increase the effectiveness of soil removal and replacement, there is also a need to investigate alternatives to this method. These alternative approaches include techniques that: 1) bury the contaminated soil in place; 2) remove the soil, clean it on site, and return it; 3) remove the lead without disturbing the soil; 4) permanently bind the lead below the surface of the soil profile.

Each of these processes, and some variations, are discussed below from a conceptual standpoint. Few studies have investigated these alternatives under field conditions. This discussion involves both the advantages and disadvantages of each process, and should not be construed as advocating any particular procedure. The decision to use any method of soil abatement must necessarily take into account site specific aspects of cost.

The views expressed in this paper are those of the author and do not necessarily reflect the views or policies of the US Environmental Protection Agency. The US Government has the right to retain a non-exclusive royalty-free license in and to any copyright covering this paper.

302 Lead in Soil

timeliness, and protection of human health that are well beyond the scope of this presentation.

Background*Site preparation*

A soil lead abatement programme requires a degree of site preparation. This involves identifying and terminating the sources of lead that are contaminating the soil. It is impractical to begin a soil cleanup programme if continued contamination is in progress. In general, the sources of lead to the soil are atmospheric deposition, dust re-entrainment, and flaking paint chips. In most areas of the United States, atmospheric deposition is no longer a major factor, with the phasedown of lead in petrol. Re-entrained dust is most commonly a problem in the vicinity of smelter and mining operations. Lead-based paint on the exterior parts of old houses may be found in any part of the country, but is more common in older urban neighbourhoods.

Site preparation is not a simple process. Some efforts to remove lead contaminated soil have been unsuccessful because of inadequate preparation that left behind enough lead to re-contaminate the fresh soil, or that did not eliminate inputs to the soil from the sources. Because of the complexity of the problem, any soil lead abatement procedure may need to be iterative. That is, site cleanup should precede soil abatement, which may re-contaminate the site, requiring further cleanup and soil abatement. Even *in situ* soil lead abatement may be only 50 percent effective and thus require a repeat of the procedure. For this reason, the frequency and cost of repeated efforts may be a factor in the selection of a soil lead abatement procedure.

Characterizing and monitoring the soil

If the soil is not removed from the site, then a clear understanding must be achieved of the important soil characteristics that affect the mobility of lead in soil. The effectiveness of the treatment must also be documented by a thorough soil monitoring programme.

Soil types are so diverse that to attempt to describe any procedure that would remove lead from all types of soil would be overly simplistic. Lead is generally found in each of five soil compartments: soil moisture, organic and inorganic exchange sites, primary and secondary minerals, chemical precipitates and biologically incorporated lead. The soil system has a finite capacity for lead in each of these compartments, and the lead concentration should be seen as a dynamic equilibrium among all of these compartments. The mobility among the last three may be orders of magnitude slower than the first two. Among the trace metals, lead is one of the least mobile elements in soil. The factors that control mobility are pH, cation exchange capacity, organic matter, surface area of clay particles, the redox potential and the amount of oxides of iron, manganese, and aluminium.

Soil Tilling

Robert W. Elias 303

Lead from anthropogenic sources generally accumulates at the surface of the soil. Most studies have found the greatest amounts of lead in the upper few centimetres of the soil profile. The organic matter in this layer often serves as a trap for lead deposited on the surface of the soil. In soils without an organic layer, and soils with large anthropogenic inputs from the atmosphere, the penetration of lead may reach 40 cm.

Soil Replacement Alternatives

The important objective of soil lead abatement is to guarantee that an effective barrier is erected between the lead and the human environment. For each alternative discussed below, the focus will be on this barrier and its effectiveness relative to other soil abatement methods.

Some attempt has been made to estimate the relative cost of each method, but this is secondary to the primary objective of isolating the lead. Site disturbance is also of some concern. In residential situations, another important objective may be to restore the site to an equal or better condition for human activity and aesthetics.

The elements of each process for soil lead abatement are: 1) excavation; 2) transportation; 3) disposal or treatment; 4) cleanup. For each element, there is a measurable physical cost that can be evaluated on engineering terms. There are other, hidden costs that are difficult to evaluate, such as disturbance of the soil profile, or the future cost of cleaning up a disposal site mistakenly believed to be adequate for contaminated soil disposal. The untimely delays in a lengthy cleanup process can also take their toll on human health. The discussion of the advantages and disadvantages for each of the alternatives presented below cannot be fully comprehensive in evaluating these real and hidden costs. Rather, the points raised are meant simply to give some direction to the preliminary evaluation of each alternative. Final acceptance or rejection must necessarily be based on a host of considerations, not the least of which would be site-specific data on effectiveness.

Covering contaminated soil

Covering contaminated soil with clean soil is feasible if the following conditions can be met: 1) the fresh soil layer is sufficiently thick to prevent the upward migration of lead to the soil surface; 2) the fresh soil has an acceptable lead concentration; 3) the mechanical application of the fresh soil, including dumping, grading and tilling, does not mix the clean with the contaminated soil; 4) the ground cover can be restored in a timely manner to prevent erosion of the new soil layer.

Soil tilling is similar to soil covering in that cleaner soil from lower in the soil profile is brought up to the surface. Soil covering or tilling eliminates excavation and disposal and reduces the cost of transportation. The effort for cleanup might be increased if the process were to require drainage and erosion control.

Soil washing

The process of soil washing has been explored for several soil contaminants, including trace metals (US Environmental Protection Agency, 1986). This method would involve excavation followed by on-site chemical treatment in a mobile unit. The chemical treatment involves the mixing of a soil slurry in a fluid capable of removing lead. The fluid is extracted, the soil is dried and re-applied to the original location. The extracted fluid can be treated to remove the lead, then recycled for further soil washing.

For trace metals, the extraction fluids that have been investigated are weak acids, reducing agents, and chelating compounds (EDTA). Because these are non-specific for lead, there is the danger that micro-nutrients would be removed, too. It is possible that recently developed techniques for selectively removing specific trace metals from sludges, using cultivated micro-organisms, could also be applied to soil washing (Premuzic and Lin, 1987). For whatever solution that might be used, it is the case that the soil profile would be disturbed, the micro-biota would be destroyed, and the soil would become completely dis-aggregated.

One advantage of a soil washing procedure is that it is a closed process that contains the contaminant lead, concentrating the solution to a manageable level. The end product for waste disposal would be a small fraction of the original volume of soil. Compared to excavation and replacement, this process eliminates the costs of transporting the soil away from the site, of disposing of the contaminated soil, of purchasing uncontaminated soil, and of transporting uncontaminated soil to the site, while adding the cost of treating the soil at the site.

Soil flushing

Soil flushing has been used in cases where the contaminant has reached the ground water system. A washing solution similar to that used for soil washing is applied to the surface of the soil and allowed to penetrate to the ground water system. The ground water is pumped to the surface through an extraction well, treated to remove the contaminant, then re-applied to the soil surface.

Most of the washing fluids would be unsuitable for direct application to the soil surface. Weak acids may become neutralized and ineffective. Chelating agents might be toxic to plants, and reducing agents would likely immobilize the lead by converting the lead to lead sulphide. It is not clear whether the cultivated micro-organisms that selectively extract lead could be used *in situ*, but even so, it is not likely that the organisms would survive below a few centimetres of soil depth.

By eliminating all costs for excavation, transportation, disposal, and cleanup, soil flushing appears to be the most cost effective alternative for soil lead abatement. Because the process is only about 50 percent effective, repeated application may be required.

A serious disadvantage of soil flushing is that it risks contamination of the ground water system. It is not a closed process and cannot be fully contained. Variability among soil types can make soil permeability

unpredictable, and the hydrology of the site cannot be established without extensive experimentation.

Modified soil flushing

Rather than attempting to flush the lead through the soil column and out through the groundwater system, it might be possible to use a specific soil treatment where the lead is only temporarily mobilized, and would revert to a stable, insoluble form after moving only a few centimetres. Alternatively, it might also be possible to selectively solubilize only one form of the lead at the surface, releasing lead to the lower part of the soil column on a controlled basis. Although field studies of this process have not appeared in the literature, the selective solubilization of lead in laboratory cultures of heterotrophic soil bacteria was reported by Cole (1979). If this form of controlled soil flushing can be developed, then it is likely to be the more effective and efficient of the several options.

Summary

Removal of lead from the human environment may be required in several heavily contaminated regions of the country where it can be shown that such lead is detrimental to human health. In the cases where this lead is in the soil, removal becomes a difficult and challenging problem. Because complete removal of the contaminated soil may be impossible, it is necessary to consider alternatives that are more efficient in protecting the human environment and more cost effective. Burying the contaminated soil or mixing it with cleaner soil has the limitation of forming an incomplete and possibly inefficient barrier between the lead and the human environment. Washing with a chemical solution may destroy the natural properties of soil and render it useless for vegetation growth. Selectively removing lead by washing or flushing with solutions of soil micro-organisms that specifically solubilize lead may release the lead to the groundwater system and threaten the human environment by another route.

The most appropriate conclusion is that treatment of the soil for lead removal is likely to be very site specific, and the most efficient and cost effective method will be determined by the concentration and form of the lead in the soil, the nature of the soil column, and the expected use of the restored land.

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Attachment C

EXHIBIT #16

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Baltimore Soil-lead Abatement Demonstration Project

Katherine Farrell

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Abstract

A three year study will be carried out in Baltimore, Maryland to test the effectiveness of measures to reduce soil contamination with lead in the prevention of lead poisoning.

High risk neighbourhoods for lead poisoning will be identified and will be assigned by random allocation to either study or control areas.

Blood lead and free erythrocyte protoporphyrin (FEP) will be obtained on children aged less than six years in both areas. Samples will be obtained by venipuncture and heelstick techniques and will be conducted in two rounds prior to abatement and again at the same times of the following two years.

Environmental abatement consisting of measures to prevent exposure to lead via soil would be carried out in the study neighbourhood after the baseline data has been collected. If soil lead abatement is found effective, it would also be performed in the control area.

This project will be carried out by the Maryland Department of the Environment in cooperation with Baltimore City and the John F. Kennedy Institute for Handicapped Children in fulfilment of a cooperative agreement between the State of Maryland and the Environmental Protection Agency.

Introduction and Background

Baltimore, Maryland has been selected as a site for a three year study of lead in soil. Baltimore shows many characteristics of other major east coast cities in terms of demographics, public health indicators, and particularly, risk of lead poisoning. Twenty-three percent of the Baltimore population is below the poverty line. Birth rates are high - 16.2% with 24% of births to teenage mothers and 60% to unmarried women. Most housing was constructed prior to 1960 and was painted with lead paint. The condition of housing is variable with most lead poisoning cases occurring primarily in substandard rental housing. About 100 Baltimore children are hospitalized annually for treatment of lead poisoning with 24% re-admissions. Thirty thousand screening tests are done annually mainly on children covered by the medical assistance programme. In 1986, 931 children had Class II blood

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lead levels. 93 children had Class III and 20 had Class IV. Estimates based on a computer model using National Health and Nutrition Evaluation Study (NHANES) data predict that even higher rates would apply if all Baltimore children were being screened. More than 25% of all city census tracts are predicted to have 8 to 16% of children under six at risk for lead poisoning.

Most lead poisoning in Baltimore has been linked to deteriorating lead paint in substandard housing. However, soil and dust have not been fully evaluated as intermediate or auxiliary pathways of exposure. In a study by Mielke *et al.*, (1983), samples of Baltimore garden soils mixed to 50-75cm (20-30 inches) were analyzed. The median level was 100 $\mu\text{g Pb/g}$ with levels above the median clustering in the oldest parts of the city close to the centre. Residential or playground soil has not been evaluated but based on other studies it is expected that considerable contamination from paint and petrol will be found.

Baltimore Project will explore the extent of soil contamination and its relationship to childhood lead poisoning. The study will also help develop and test soil abatement methods as prevention tools.

Project Description

The purpose of this project is to investigate the effects of removal and/or abatement of lead contaminated soil with respect to childhood lead exposure. The main hypothesis (stated as the null hypothesis) is as follows:

A significant reduction ($\geq 1.000 \mu\text{g Pb/g}$) of lead in soil accessible to children will not result in a significant decrease in their blood lead levels (equal to or greater than $3-6 \mu\text{g/dL}$). This hypothesis will be tested for significance by comparing indices of lead exposures in the study and control areas before and after soil abatement.

The study and control areas will be assigned by a random method after suitable candidate neighbourhoods have been identified. At least 100 children in the study area and 100 children in the control area must complete the protocol. In order to ensure a sufficient population base, birth rates in the target areas will be closely scrutinized and used in the selection process.

In order to select suitable study and control areas, we propose to draw upon previous studies and data sources as well as perform soil sampling from candidate sites in Baltimore City. Since Baltimore has been the site of extensive soil studies in the past, the results of these studies will form a basis for initial identification of possible sites.

Baltimore City, like many older urban centres, has a large number of housing units painted inside and outside with lead paint. Vehicular traffic patterns are such that automobile exhaust also makes a significant contribution to street dust and soil lead. There is a large body of information on patterns of lead poisoning in the city from screening results, number of hospitalizations and previous studies. In addition, there are data sources on risk factors such as socio-economic status, race, age and housing.

A further consideration is that they should not be confounding results by receiving day care in neighbourhoods where frequently residing often shared with them. Although families residence to another blocks away. The study needs to drop out from the study to it.

Children from birth have blood samples protoporphyrin (FEP) women will also be burdens to compare. Baseline biological study and control are in late summer (for winter. Soil abatement rounds of sampling comparable seasonal terms of biological and consider these differ well as where possible.

The schedule of biological as follows:

Pre-abatement

- Two samples later

Post-abatement

- Two samples in
- Two samples in

A child who is enrolled tested six times in the six during the study depending on the physician women will be tested at the present address inclusion.

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A further consideration in selection of the study and control areas is that they should not be directly bordering neighbourhoods. This will avoid confounding results from crossover with children residing in one area and receiving day care in the other or moving from one to the other. Baltimore neighbourhoods tend to be close knit communities with extended families frequently residing within a few blocks of one another. Care of children is often shared with grandparents or other family members living close by. Although families in low income rental properties move from one residence to another very frequently, they seldom move more than a few blocks away. The selection of non-contiguous neighbourhoods will reduce the need to drop subjects from the study because of change of residence from the study to the control area or vice versa.

Children from birth to age six residing in the study and control areas will have blood samples taken for both blood lead (PbB) and free erythrocyte protoporphyrin (FEP) as standard indices of lead exposure. Pregnant women will also be tested to ascertain *in utero* measures of body lead burdens to compare with post natal values obtained on their children. Baseline biological sampling will be performed prior to abatement in the study and control areas in the first year of the study with one sample drawn in late summer (for peak seasonal lead level) and a second round in mid winter. Soil abatement is planned for early spring. After abatement further rounds of sampling would occur in late summer and midwinter to obtain comparable seasonal levels of blood lead and FEP. Age differences exist in terms of biological uptake and storage of lead. We therefore, propose to consider these differences in terms of statistical handling of the results as well as where possible selecting very young children.

The schedule of biological samples drawn over the three period would be as follows:

Pre-abatement

- Two samples late summer and mid winter, 1988.

Post-abatement

- Two samples in 1989 - late summer and mid winter.
- Two samples in 1990 - late summer and mid winter.

A child who is enrolled for the entire period of the study would, thus, be tested six times in the course of three years. Children born or reaching age six during the study or entering later would have less than six tests depending on the phase where they enter or leave the protocol. Pregnant women will be tested only once preferably in the third trimester. Residence at the present address for at least three months will be a prerequisite for inclusion.

Counselling and appropriate medical referral will be provided to all those with positive findings of either elevated blood lead levels or abnormal FEPs.

Transportation will be provided to and from sampling sites on passenger vans equipped with safety restraints and car seats suitable for infants and

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children. Samples will be transported to the State Laboratory on the date of collection.

Environmental lead measurements will be done before and after abatement to evaluate the various sources of lead in the environment, to ascertain the need for, and effectiveness of soil abatement, and to determine the approximate rate of recontamination after abatement. These measurements will include lead in soil, house and street dust, water and food lead, interior and exterior paint, and miscellaneous suspect sources of lead such as cosmetics or folk remedies.

The goal of the soil abatement strategy will be to reduce surface soil contamination to a level not exceeding 500 $\mu\text{g Pb/g}$ either by removal, covering or mixing. Exterior lead paint will be assessed for stability and, if necessary, a limited abatement will be carried out to prevent reaccumulation of lead from this source.

After sampling, soils will be placed in several categories and the yards and exterior surfaces will be marked to indicate the appropriate action for each location. A map of the area will be marked with the sample results and keyed to indicate which action is to be taken.

Categories of soil contamination

1. Greater than 1,000 $\mu\text{g Pb/g}$ lead failing the EP toxicity test.
2. Greater than 1,000 $\mu\text{g Pb/g}$ containing less than 6 $\mu\text{g Pb/g}$ leachable lead.
3. 600-1,000 $\mu\text{g Pb/g}$ lead.
4. Less than 500 $\mu\text{g Pb/g}$ lead.

Several different techniques will be used with soil contaminated at various levels. Soil contamination at greater than 1,000 $\mu\text{g Pb/g}$ lead and containing less than 6 $\mu\text{g Pb/g}$ leachable lead according to the EP toxicity test will be removed to the Woodbury Quarry landfill or other authorized landfills and used as cover dirt. Alternatively it may be covered with concrete or similar permanent covering material with a minimum thickness of 10 cm (4 inches), or disposed on-site by excavating an area deep enough to contain the contaminated soil with a 60 cm (2 feet) cover of uncontaminated soil.

Soil that is contaminated at greater than 1,000 $\mu\text{g Pb/g}$ lead and failing the EP toxicity test for leachable lead cannot be landfilled and must be handled as a hazardous waste.

Surface soil contaminated between 600-1,000 $\mu\text{g Pb/g}$ may be tilled using a garden-type rototiller in order to reduce the level of surface contamination by dilution with subsurface soil provided deeper soils are less contaminated. Abated soil will be regrassed. Water spray will be used to reduce dust produced during tilling or removal. Covering as previously described may be an alternative depending on the wishes of the owner. During and following rototilling and soil removal, procedures will be followed to control runoff into storm drains or streams and to minimize fugitive dust or tracking of soil into homes. Field analyzers will be used at

the site to determine when the site is safe for play.

In order to encourage an outline incentive to encourage improvements to the cleanup of debris, gr. of exterior surfaces, parking space.

Advantages for public contiguous public a preserving or restoring incentive scheme to losses due to turnover good incentive program right of entry to property.

Incentives for studies of screening and a reward. Incentives will be a welfare benefits while.

If soil abatement blood lead by the areas the following abatement testing to of the study.

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the site to determine when contaminated soil has been adequately removed.

In order to encourage the cooperation of property owners and residents, an outline incentive scheme is included. Participants can expect significant improvements to the neighbourhoods through correction of safety hazards, cleanup of debris, grading and sodding of yards, painting and stabilization of exterior surfaces, and in some cases where covering is used, additional parking space.

Advantages for property owners will be upgrades to the property or contiguous public areas improving the quality of life in the area and preserving or restoring the condition of the property. In addition, the incentive scheme to promote stability of tenant populations will reduce losses due to turnover in the study and control populations. Provision of a good incentive programme will also decrease potential for problems with right of entry to properties.

Incentives for study subjects will provide immediate benefit at the time of screening and a major benefit at time of completion of the protocol. Incentives will be chosen to avoid interference with social security or welfare benefits while aiming at achieving better health and quality of life.

If soil abatement is found to be associated with significant reduction in blood lead by the end of the first year, it will be carried out in the control areas the following spring. The results will then be added to the post-abatement testing for statistical analysis, potentially adding to the strength of the study.

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WILLKIE FARR & GALLAGHER

Steven A. Tasher

Washington, DC
New York
London
Paris

January 3, 1991

VIA TELECOPIER

Mr. Steven Siegel
Office of Regional Counsel
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, IL 60604

Re: Taracorp Superfund Site
Granite City, Illinois

Dear Mr. Siegel:

Confirming our conversation of Thursday, January 3, 1991, NL is prepared to perform, subject to appropriate participation of other potentially responsible parties ("PRPs"), the following tasks at the above entitled site: 1) the Remedial Design, including tasks a-f set forth in my letter of December 26, 1990 to you, Brad Bradley and Steve Davis, which will include development of a plan for risk assessment for the site that is acceptable to USEPA and implementation of those tasks upon approval by USEPA; 2) a pilot study to determine the efficacy of deep tilling lead-bearing off-site soils to achieve a 500-part per million level as an alternative to excavation of such soils. The details of this task were set forth in my December 26, 1990 letter and will be supplemented by a draft scope of work for the project which will be sent to you as soon as possible under separate cover; 3) upon completion of Tasks (1) and (2), the Remedial Action for the site, as determined by the USEPA, but subject to fair and appropriate Dispute Resolution by a party other than USEPA (e.g., a federal district judge).

We present these conceptual ideas without admission of liability and in the spirit of compromise and cooperation and emphasize that the ideas set forth are not cast in concrete but are subject to your input and suggestions.

90-11-3-608

JAN - 9 1991

Three Lafayette Centre
1155 21st Street, NW
Washington, DC 20036-3302
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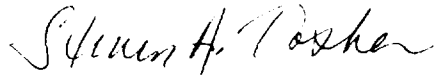
Telex: RCA 229800
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Fax: 202 887 8979
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Mr. Steven Siegel
January 3, 1991
Page 2

We would agree, however, that the pilot study for deep tilling as well as the risk assessment tasks in the Remedial Design be conducted simultaneously with all Remedial Design tasks, not delay those activities and be completed within a mutually acceptable timeframe. Furthermore, we would agree conceptually that the Dispute Resolution provisions would not affect the schedule for the conduct of Remedial Action activities.

In order to pursue these concepts further, we are available to meet with you along with other interested PRPs at your earliest possible convenience.

Sincerely,

A handwritten signature in cursive script, appearing to read "Steven A. Tasher".

Steven A. Tasher

cc: Allen Held

WILLKIE FARR & GALLAGHER

Steven A. Fisher

Washington, DC
New York
London
Paris

January 8, 1991

Via Telecopier

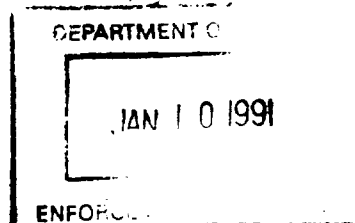
Mr. Steven Siegel
Office of Regional Counsel
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, IL 60604

Mr. Allen Held
Environmental Enforcement Section
Department of Justice
P.O. Box 7611
Ben Franklin Station
Washington, D.C. 20044

Re: Taracorp Superfund Site
Granite City, Illinois

Gentlemen:

On Thursday, January 3, 1991, NL Industries formally apprised you of its willingness to perform, subject to appropriate participation of other potentially responsible parties ("PRPs"), the following tasks at the above entitled site: 1) the Remedial Design, including tasks a-f set forth in my letter of December 26, 1990 to you, Brad Bradley and Steve Davis, which will include development of a plan for risk assessment for the site that is acceptable to USEPA and implementation of those tasks upon approval by USEPA; 2) a pilot study to determine the efficacy of deep tilling lead-bearing off-site soils to achieve a 500-part per million level as an alternative to excavation of such soils; and 3) upon completion of Tasks (1) and (2), the Remedial Action for the site, as determined by the USEPA, but subject to fair and appropriate Dispute Resolution by a party other than USEPA (e.g., a federal district judge). That communication was simultaneously sent to a representative of the PRP Steering Committee who disseminated the offer to other Committee members. Since that time, we have attempted to meet with the Steering



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Mr. Steven Siegel
Mr. Allen Held
January 8, 1991
Page 2

Committee in order to achieve a global settlement as expeditiously as possible. The enclosed correspondence describes discussions between NL and some members of the Steering Committee which lead us to believe that the Committee has no intention of engaging in discussions with NL to achieve a global settlement at the site.

We were informed late Friday afternoon, January 4, 1991 that members of the Steering Committee have been negotiating for the past month what is characterized as a "generator carve-out" which will involve a payment of "significantly less than 50% of the estimated cost of the ROD remedy" in exchange for which all generator Order recipients will receive a "complete release." Despite repeated attempts to elicit details of this "carve-out," the Steering Committee representatives have refused to provide any further information.

If USEPA is in fact considering a partial settlement with some or all of the generators at this site, it should provide the details of that partial settlement to NL for two reasons: First, this could facilitate a global settlement as NL might be willing to fund whatever work would remain to be done if the partial settlement is approved. Second, if USEPA has changed its position and now wishes to consider a partial settlement at the site, NL might very well be in a position to offer a more attractive partial settlement than that being offered by the generator group. In particular, a settlement under which NL would fund a significant portion of work would leave USEPA with almost fifty PRPs from whom to recover its remaining costs, a result far more favorable to the Agency than looking only to NL for the remaining costs.

NL reiterates its willingness to enter into good faith negotiations with the Agency and the other PRPs in the hope of achieving a global settlement at this site. If that should prove impossible, NL is willing to explore a partial settlement. I would appreciate it if you contact us at your earliest convenience to discuss this matter.

Sincerely,



Steven A. Tasher

Environmental Geochemistry and Health
MONOGRAPH SERIES 4

Supplement to Volume 9 of
Environmental Geochemistry and Health

**Lead in Soil:
Issues and Guidelines**

Edited by

BRIAN E. DAVIES

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SCIENCE REVIEWS LIMITED

Lead in Soil: Issues and Guidelines

SCIENCE REVIEWS LIMITED

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January 16, 1991

VIA FEDERAL EXPRESS

Mr. Brad Bradley
Remedial Project Manager
U.S. EPA, 5 HS-11
230 South Dearborn Street
Chicago, Illinois 60604

RE: NL/Taracorp Site Notice of Intent to Comply to
Section 106 Order

Dear Mr. Bradley:

Please accept the following as St. Louis Lead Recyclers ("SLLR") response to paragraph 30 of the Section 106 Order requesting of PRP's notice of their intent to comply with their order.

SLLR will not be performing the remedy described in the Section 106 Order for the following reasons:

1. As explained SLLR's letter of August 31, 1990, (see attached) the Order is illegal to the extent it seeks to impose joint and several liability on SLLR. SLLR's activities remediating a portion of the pile and reducing the entire volume of waste to be managed by U.S. EPA and the PRP's is divisible and is restricted to a small portion of the overall site located on Trust 454 property;
2. On August 31, 1990 SLLR submitted a good faith offer in which SLLR proposed to address the divisible portion of the site where SLLR's operations took place. In order to resolve its potential liability, SLLR agreed to perform remediation regarding the rubber chip pile and certain soils notwithstanding the fact that NL and numerous other PRP's also face potential responsibility for these areas;
3. The Section 106 Order imposes a cleanup level for lead under 1,000 parts per million without the benefit of a feasibility study;

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4. The selection of cleanup levels by EPA was inconsistent with the NCP.
5. SLLR does not have the financial capability to perform the entire remedy as set forth in the Section 106 Order. As such, compliance with the Order by SLLR is in fact impossible.

SLLR is monitoring settlement discussions between U.S. EPA and the lead PRP's and is hoping to participate in a compromise remedy.

If you have any questions regarding the foregoing, please do not hesitate to call.

Very truly yours,



George M. von Stamwitz

GMS/nnh

cc: Stephen E. McAllister
Andrew R. Leeper, Esq.

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August 31, 1990

**CERTIFIED MAIL
RETURN RECEIPT REQUESTED**

Mr. Brad Bradley (5HS-11)
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

**RE: NL Industries/Taracorp Site
Granite City, Illinois
Response to Special Notice Letter by St. Louis Lead
Recyclers**

Dear Mr. Bradley:

This correspondence will formally respond to USEPA's Special Notice Letter dated June 25, 1990, on behalf of St. Louis Lead Recyclers ("SLLR"). The statements and commitments in this letter are made only for purposes of seeking a settlement and do not constitute an admission of liability for the remediation at the NL/Taracorp Site ("Site").

As explained in detail in SLLR's response to the §104(e) request, SLLR did not generate any waste designated for the NL/Taracorp Site within the meaning of CERCLA. Rather, SLLR was hired by Taracorp to recycle the pile. All of the material handled by SLLR originated from the pile itself; there was no other source of lead bearing materials to SLLR's process other than the NL/Taracorp pile. SLLR's process ran for approximately one year when it ceased because of Taracorp's bankruptcy proceeding.

SLLR's process separated material from the NL/Taracorp Pile into five components: metallic grid lead, lead oxide paste, plastic case material, hard rubber case material and slag and other trash. Material was given back to Taracorp in three forms pursuant to the tolling contract: metallic lead blocks (approximately 2,000 pounds each) lead oxide paste which was returned to Taracorp for the production of lead products; slag and trash materials, which were screened out of SLLR's process were

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returned to the Pile. In essence, SLLR's process was a closed circular stream of material from the NL/Taracorp Pile back to Taracorp in the form of product and slag. In short, SLLR reduced the amount of waste to be remediated at the Site.

SLLR's role at the Site as a recycler supports a resolution of its potential liability independent from the other PRPs. The only impact on the Site caused by SLLR is the movement of waste from the large pile to the smaller rubber chip pile and the removal of lead from those wastes. As such, SLLR's involvement at the NL/Taracorp Site is clearly divisible. SLLR is not a PRP for the larger pile or for wastes that went into NL's or Taracorp's process. Accordingly SLLR does not face the prospect of joint and several liability at the Site. See United States v. Chem-Dyne, 572 F.Supp. 802 (S.D. Ohio 1983) ("If the harm is divisible and if there is a reasonable basis for apportionment of damages, each defendant is liable only for the portion of harm he himself caused." Id. at 811).

While the generators and owners/operators, whose hazardous waste created the NL/Taracorp pile was transshipped to SLLR, are strictly liable for the rubber chip pile as generators, SLLR, in a good faith effort to resolve its liability at the NL/Taracorp Site, is prepared to assume responsibility in the first instance for addressing the wastes located at the former SLLR facility; that is, address the divisible portion of the total Site which is linked to SLLR. In general, SLLR is prepared to excavate the rubber chip pile, combine this material with the NL/Taracorp pile and excavate soil beneath and around the rubber chip pile to the depth of six (6) inches. The activities SLLR is prepared to undertake are described in more detail below and in the attached Statement of Work.

SLLR has elected not to join the Group of generators which has been formed to respond to EPA's Special Notice Letter. SLLR was erroneously listed as the seventeenth (17) largest generator of the NL/Taracorp pile on the Waste-In List notwithstanding the fact that SLLR was not a generator at all. Due to time constraints, the Group has not been willing to resolve SLLR's status before the Group responds to the Special Notice Letter and thus, the Group demanded a proportional financial commitment from SLLR far in excess of SLLR's exposure.

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Mr. Brad Bradley (5HS-11)
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The following commitments, together with the attachments to this letter, constitutes SLLR's Good Faith Offer for performing portions of RD/RA which are related to SLLRs divisible involvement at the Site:

1. SLLR is willing to excavate the rubber chip pile located on Trust 454 property and any soil directly beneath or around the rubber chip pile impacted by the pile to the depth of six (6) inches, and remove such excavated material to the NL/Taracorp pile.
2. As indicated previously, SLLR's involvement at the NL/Taracorp Site is clearly divisible from the owners/operators and generators of the NL/Taracorp pile; therefore, SLLR proposes only to deal with that portion of the Record of Decision which involves the rubber chip pile. The ROD contains numerous inaccuracies regarding the rubber chip pile and as does the RI/FS documents drafted by NL. SLLR submitted comments to the Proposed Plan to correct these inaccuracies. A copy of these comments is attached as Exhibit A.
3. A Statement of Work is attached hereto as Exhibit B. This document identifies how SLLR plans to proceed with the Work. SLLR will develop in conjunction with USEPA a more detailed statement of work for purposes of the final consent decree.
4. SLLR has the technical capacity to undertake the RD/RA. SLLR has retained Dames & Moore as its consultant for this matter.
5. Upon acceptance of this offer, SLLR will negotiate a financial assurance provision in the Consent Decree providing for either a letter of credit, third-party guarantee, a performance bond or a financial test.
6. SLLR is willing to enter into a reasonable agreement with USEPA regarding direct oversight costs for that portion of the response at the NL/Taracorp Site to be conducted by SLLR.

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United States Environmental
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Page Four

7. SLLR will be represented in these negotiations on legal issues by:

George M. von Stamwitz, Esq.
Armstrong, Teasdale, Schlafly, Davis & Dicus
One Metropolitan Square, Suite 2600
St. Louis, Missouri 63102-2740
(314) 621-5070; and

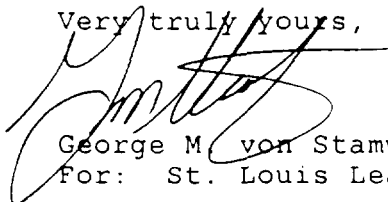
on technical issues by:

Neal Jost
Dames & Moore
11701 Borman Drive, Suite 340
St. Louis, Missouri 63146
(314) 993-4599

8. SLLR's willingness to perform the remedy is conditioned upon the receipt of the broadest release from liability allowed by law, and a commitment by USEPA and IEPA that the performance of the remedy satisfies all the requirements of other state and federal programs which have, or potentially have, jurisdiction over the rubber chip pile.

We look forward to initiating negotiations on a consent decree and promptly resolving the issues relating to SLLR's involvement at this Site. If you have any questions or comments about the position of SLLR, please contact me.

Very truly yours,



George M. von Stamwitz
For: St. Louis Lead Recyclers

GMS:kb

cc: Andrew R. Leeper, Esq.
Stephen E. McAllister
Neal Jost



DAMES & MOORE

A PROFESSIONAL LIMITED PARTNERSHIP

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(314) 993-4599 FAX NO. (314) 993-4895

March 12, 1990

Ms. Mary Ann Croce LaFaire
Community Relations Coordinator
U.S. EPA (5PA-14)
230 South Dearborn Street
Chicago, IL 60604

**RE: NL Industries/Taracorp Site-Comments of
St. Louis Lead Recyclers ("SLLR") to
Draft Feasibility Study and Proposed Plan**

Dear Ms. LaFaire:

We have reviewed the Draft Feasibility Study for the Taracorp Site in Granite City, Illinois, dated August 1989, the Addendum to the Draft Feasibility Study Report, dated January 10, 1990, the U.S. EPA's Proposal Plan for the NL Industries/Taracorp Site, Granite City, Illinois, dated January 10, 1990. SLLR would like to comment on several errors contained in these documents. Our comments are enclosed as Attachment A. Please include these comments in the Administrative Record.

Should you have any questions or require further information, please do not hesitate to contact me.

Very truly yours,

DAMES & MOORE
A Professional Limited Partnership

Neil J. Jost, P.E.
Associate

njj/ket

Enclosure

cc: Steven McAllister, Galena Industries
Jim Stack, Galena Industries
George von Stamwitz, Esq.
Donald J. Harvey, Dames & Moore



WILLKIE FARR & GALLAGHER

Steven A. Tasher

Washington, DC
New York
London
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January 8, 1991

Via Telecopier

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Dennis Reis, Esq.
Sidley & Austin
One First National Plaza
Two South Dearborn
Chicago, Illinois 60603

Re: NL/Taracorp Superfund Site
Granite City, Illinois

Dear Ladies and Gentlemen:

This will confirm the position set forth in Janet Smith's and my conversation with Mark Hester and Dan Bicknell on January 7, 1991, wherein NL stated its willingness to perform, subject to the appropriate participation of other potentially responsible parties ("PRPs"), the following tasks at the above referenced site: (1) the Remedial Design, including tasks a-f set forth in my letter of December 26, 1990 to Steve Siegel, Brad Bradley and Steve Davis, which will include development of a plan for risk assessment for the site that is acceptable to USEPA and implementation of those tasks upon approval by USEPA; (2) a pilot study to determine the efficacy of deep tilling lead-bearing off-site soils to achieve a 500-part per million level as an alternative to excavation of such soils; and (3) upon completion of Tasks (1) and (2), the Remedial Action for the site, as determined by the USEPA, but subject to fair and appropriate Dispute Resolution by a party other than USEPA (e.g., a federal district judge).

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This position was communicated in my conversation with Steven Siegel of the USEPA on January 3, 1991, and formalized in a letter of same date, a copy of which was simultaneously forwarded to a member of the Steering Committee and subsequently disseminated to the Committee members.

NL remains ready to commence discussions on all aspects of a global settlement, and has expressed its willingness to participate in discussions with the PRPs, the Department of Justice and the USEPA.

We have been informed by Mark Hester and Dan Bicknell that certain members of the Steering Committee have been negotiating what is characterized as a "generator carve-out," which will involve a payment of "significantly less than 50% of the estimated cost of the ROD remedy" in exchange for which those settling parties (which Messrs. Hester and Bicknell indicated include all or virtually all of the generator recipients of the Administrative Order) will receive a "complete release."

We were offered the opportunity to join in that settlement in order to make it a global settlement, on the condition that NL unilaterally inform the Steering Committee of the amount of its contribution to the settlement. Our request for all meaningful details of the proposal, including the form of release, contribution protection, dispute resolution provision, the scope of work, the identity of the parties participating, and the history and specific details of negotiations with the USEPA and DOJ has been refused.

We believe it is unrealistic to expect NL to commit to authorize many millions of dollars toward settlement within a few hours of time, and it is particularly egregious to expect NL to provide such agreement without being provided with any of the details required to meaningfully analyze the request. We are confident that none of the PRPs making such request would provide an affirmative response under such conditions were the request directed to them. Indeed, the Group is unwilling to divulge either how much it collectively expects to pay or how much it seeks from NL. Despite this, we emphasize our willingness to work with the Steering Committee to achieve a global settlement along the lines set forth in my January 3, 1991 letter to Steve Siegel, and further note that NL will bear a share of that settlement at least equal to the largest generator contribution.

We are told that negotiations with the Government have been ongoing for at least one month. We are surprised by this development for several reasons. First, we have repeatedly tried to meet with the Steering Committee in an effort to frame a settlement offer to USEPA but have been rebuffed. We specifically asked representatives of the Committee whether ongoing negotiations between USEPA and the Steering Committee were taking place and were informed that, with the exception of technical discussions on roto-tilling, no settlement discussions were taking place. At the December 21, 1990 Administrative Order Conference, when NL pressed for a pilot project for roto-tilling (which we understand may be a component of the "generator carve-out" deal), neither USEPA, DOJ or the order recipients involved in already ongoing "carve-out" negotiations informed NL of the existence of those negotiations. Most distressing, when one of the Order recipients inquired whether USEPA would agree to a partial or individual settlement of this matter, the USEPA representative ruled out any such arrangement, emphasizing USEPA's desire for a global settlement for the site.

We believe that the details of the "generator carve-out" should be provided to us immediately. At all times since the issuance of the general notice letter, NL has expressed the desire to be a settlor and to work towards cleaning up the site. Therefore, NL should be offered the opportunity to participate in the carve-out offer and will immediately contact USEPA and the Department of Justice to obtain the details of the secret arrangements. We have taken USEPA at its word that it lacked the resources and the desire to allocate responsibility between PRPs in this matter. Since USEPA now appears to have reversed its position on that issue, by agreeing to an allocated percentage for generators, we will immediately seek an audience with USEPA and DOJ in order to explore an equivalent NL carve-out. The government may indeed look favorably upon such an arrangement with one PRP as opposed to nearly fifty since such a resolution would still leave the Government with a substantial number of viable PRPs to pursue for all other aspects of the remedial action. Additionally, we emphasize that the details of the generator "carve-out" are essential to NL's evaluation of the global settlement, and we therefore reiterate our request for those facts.

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We look forward to working with you toward achieving a global settlement of this matter and express our preference for proceeding in that manner. If, however, the PRP Steering Committee does not truly intend to include NL in its negotiations with USEPA and the DOJ or insists on doing so only on conditions that are unrealistic and one-sided then we will immediately contact USEPA and DOJ regarding a carve-out or similar arrangement on behalf of NL.

Sincerely,

A handwritten signature in cursive script, reading "Steven A. Tasher".

Steven A. Tasher

cc: Steve Siegel
Allen Held

COBURN, CROFT & PUTZELL

ATTORNEYS AND COUNSELORS AT LAW

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JOSEPH G. NASSIF

REPLY TO ST. LOUIS

January 9, 1991

**Mr. Steven Siegel
Assistant Regional Counsel
U.S. Environmental Protection Agency
5CS-TUB-3
230 South Dearborn
Chicago, Illinois 60604**

**Re: NL Industries/Taracorp, Customer Class Carve Out
Proposal**

Dear Mr. Siegel:

Since it was not possible for the parties to meet this week, the Customer Carve Out Group agreed to respond in writing to your letter of December 24, 1990 by January 9, 1991. Before we address the specific points contained in your letter, we thought it important to clarify our position. There is a group of customers who are interested in proceeding with the remedy on the basis of a carve out. We have proposed in our letters to EPA that this carve out involve acceptance of the clean up levels set forth in the ROD, performance of the remedial design in conjunction with a pilot study on tilling, and implementation of the remedy up to a maximum of 35%. There are other points in our proposal including selection of tasks, preservation of rights against NL, etc. It is important that you understand that it is not anyone's intention to delay the remedial design or the remedy in any way while the tilling study is being done. We, too, are interested in a solution which is protective of human health, considers all appropriate technology and does not slow down implementation of the remedy. We believe that our proposal is consistent with all of these elements and represents a no lose position for Region V. Region V will obtain acceptance of its cleanup level without a customer challenge plus implementation of a substantial portion of the remedy, as well as the completion of the remedial design.

As I indicated to you, there are a number of the major customers who have not yet committed to this proposal. They have indicated in our on going discussions that if we can obtain a commitment to a tilling study of the sort attached

Mr. Siegel
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hereto, that they will seriously consider settlement. This would give us the possibility of making a commitment consistent with Point 1 of your letter of December 24, 1990. Without a tilling study, there can be no commitment to implementation of 35% of the remedy.

If a study of tilling is not included in the proposal, less than 50% of the viable customers by volumetric share will participate. This will force the remaining customers to pay several times their respective volumetric shares in order to pay for 35% of the remedy. If EPA is firm on both points 1 and 4, you will face a united front, including N.L., in any litigation. This is just what N.L. would like to see EPA do. On the other hand, if the EPA will commit to a study of tilling in conjunction with the remedial design investigation, there is an excellent chance that a customer group will agree to implement 35% of the remedy.

While we agree that further discussion is necessary, we do not believe that Points 2 or 3 of your letter will keep the parties from reaching an agreement. However, Point 4, particularly in combination with point 1, is a deal breaker.

There is nothing in our proposal which is necessarily inconsistent with the Record of Decision. The Record of Decision calls for remediation of soils with lead levels above 500 ppm. The tilling study would look at whether or not soils can be remediated, consistent with the ROD, without the need for excavation. If the study shows that tilling is not effective, excavation would be the remedy used to reduce lead levels. Performing a tilling study is consistent with Dr. Elias' article* which was discussed in AT&T's December 28, 1990 letter, and has been used at several different sites.

As you know, in a number of these sites, tilling was tested and not used for various reasons. These reasons in each instance are related to site-specific conditions. Although tilling was not found to be usable in the Baltimore situation, in our conversations with Dr. Elias we learned that tilling is still being tested in Cincinnati. The main constraint to utilization of this technology is the requirement that the

*As you requested, attached hereto is a copy of the cover of the book from which Dr. Elias' article was taken.

Mr. Siegel
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surface and subsurface soils allow for tilling. In the Baltimore situation it was found that the inner city surface and subsurface conditions were not conducive to tilling. However, according to the Madison County, Illinois Soil Conservation Service Report and conversations with ISCS personnel, the soil types at and about the Granite City site are favorable to tilling. The soils in the Granite City, Illinois area are alluvial deposits comprised of silty soils with pockets of sand and gravel. Specifically, the following areas and their soil series demonstrate the potential for tilling to work at the site: Granite City - Beaucoup Series - silty clay loam; Madison - Rozetta Series - silty clay loam; and outer margins of Madison - Tice Series - silty loam and Landes Series - very fine sandy loam.

The results of the Exide work in Selma, Alabama using tilling to abate elevated levels of soil to a level below 500 ppm are very impressive. The information collected by Exide before and after tilling, previously provided to EPA, demonstrates that on an average for all front lawn tilling locations there was a reduction factor of 13.5 fold for those locations with specific lead concentrations. This factor represents about the expected soil-lead reduction when a 1" layer of contaminated soil is mixed or blended over an approximate 12" layer of soil. We have recently had our technical people go back and review the soil lead profiles at the Granite City site, and based on that review and the information received from ISCS it appears that tilling has a high probability of success in the Granite City situation.

Throughout our discussion, EPA has expressed reservations that a pilot scale study of tilling would stall implementation of the remedy. Following our phone conversation, we put together a remedial design time line. Although we have not finalized the time line, what we have learned is that it will take much more time to complete the Remedial Design Investigation (RDI) then it will take to conduct the pilot scale study. GM has projected as part of the time line review that it will take about twice as long to conduct the actual residential soils field work portion of the RDI (not including the ditch and alley driveway work) as to do the fieldwork for a pilot scale study on tilling. Performing the RDI parallel with the tilling study will not delay remediation at all. In fact, if tilling is found to be effective it will substantially reduce the time necessary to complete remediation.

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EPA should not lose sight of the fact that if it agrees to the pilot study on tilling, it would substantially improve its case against any non-settling PRPs. In particular, it will put substantial pressure on non-settlers to reach an agreement not only with the settling customers but with the EPA as well. Following our conversation on January 5th, a group of the customers, not otherwise involved in litigation with N.L., made an effort to bring N.L. into this process. N.L. has been calling some of the customers, saying that it was interested in reaching a resolution. The Customer Carve Out Group also met with some of the customers who have been involved in litigation with N.L. Discussions with N.L. have stopped because they did not live up to their commitment to provide the customers with an allocation percentage. As you know, the customers have been requesting a percentage from N.L. since 12/18/89. Their latest letter, a copy of which was sent to you, does not reflect what actually took place during our discussions.

In our conversation of January 5, 1991, you expressed concern as to whether there would be sufficient time to review the results of the study. We have already addressed the fact that there should be sufficient time to review the results while the remedial design investigation is proceeding. Also, there is quite a bit of work that will need to be done before that portion of the work which might involve tilling could be started. In addition, we have given some thought as to how we might set up a credible group of experts to look at the tilling results to see if the design parameters of the study have been met. Essentially they would serve as an independent review of whether or not the tilling remedy will meet the cleanup parameters in the ROD. This group would not be asked to make any changes to the cleanup parameters.

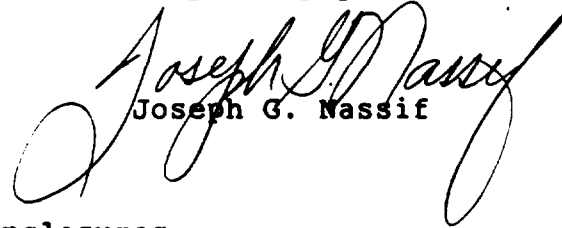
We have learned that Dr. Renate Kimbrough, who was formerly with the Centers for Disease Control and who currently holds the position of Director of Health and Risk Capabilities, U.S. EPA, Washington, D.C., will be leaving the agency sometime during the month of February. Dr. Kimbrough has extensive background in the toxicity and absorption of lead. Dr. Kimbrough might be willing to chair the review group. We would also suggest including within this group Dr. Robert W. Elias, who is currently with the Environmental Criteria and Assessment Office, U.S. Environmental Protection Agency, Research Triangle Park. As you know, Dr. Elias has written on this very subject and I believe he is speaking at the seminar you and Brad are attending in Colorado pertaining to soil lead abatement. The third member of the group would be someone assigned to represent Region V. The last member of the group would be an

Mr. Siegel
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expert selected by the settling customers. We believe this approach should satisfy any concerns that the agency, the settling customers, or anyone else might have regarding review of the results of the tilling study.

As far as the other items which follow point #4 in your letter, we do not see any of these as posing a threat to the successful conclusion of the negotiations. There is very little risk to the EPA in agreeing to go forward with the tilling study and a tremendous benefit to such an agreement. We would propose that the same parties meet on January 15, 1991 in your offices. We believe that shortly after this meeting we will know whether an agreement is possible.

Very truly yours,



Joseph G. Nassif

JGN/cn/27850
Enclosures

cc: Mr. Brad Bradley - w/enclosures
Mr. Alan Held - w/enclosures
Mr. Alan Schlesinger - w/enclosures
Mr. David Butterworth - w/enclosures
Mr. Stuart Williams - w/enclosures
Mr. Mark Hester - w/enclosures
Mr. Dan Bicknell - w/enclosures

1/9/91

NL INDUSTRIES/TARACORP SITE - GRANITE CITY, IL

PILOT SCALE STUDY

SOIL TILLING

(Prepared and Submitted by Settling Generators)

Project Description and Site Background

This document presents a protocol to conduct a pilot scale study for evaluating the site-specific implementability of the soil-tilling technology in treating lead contaminated soil at the NL Industries/Taracorp Superfund site in Granite City, IL. Site soils containing lead between 500 ppm and 1,000 ppm may be treated using soil-tilling, in lieu of excavation and capping, to achieve the EPA Record of Decision performance standard of 500 ppm soil-lead. Site soils containing lead greater than 1,000 ppm will be part of this study to define the limits of tilling to abate elevated lead concentrations in soil.

This site is a mixture of industrial, commercial and residential areas which may have been historically impacted by lead emissions from the past NL Industries/Taracorp secondary lead smelter. Residential soil-lead levels have been evaluated as part of the RI/FS for this site. Local soil conditions may accommodate the utilization of soil-tilling to reduce soil-lead concentrations. The soils in the Granite City area are alluvial deposits comprised of silty soils with pockets of sand and gravel (i.e., Beaucoup Series - silty clay loam, Rozetta Series - silty clay loam, Tice Series - silty loam, Landes Series - very fine sandy loam).

Remedial Technology Description

Tilling of soil is an existing technology that uses standard garden or farming equipment to reduce the level of surface contamination by mixing with subsurface soil or replacement soil. The technique utilizes the physical and chemical properties of lead which tend to fix lead in the upper horizon of the soil. The mixture of this

upper soil layer with lower soil regions or non-contaminated soil generates a reduction in soil-lead levels. This technique has been evaluated as a component of remediation at a number of lead contaminated sites and is a method of choice in the draft Minnesota Pollution Control Agency - Rules for Soil Lead. In addition, at the Lead in Soil: Issues and Guidelines conference (sponsored by the U.S. Environmental Protection Agency, International Lead Zinc Research Organization, Lead Industries Association, The Society for Environmental Geochemistry and Health, and Clemson University College of Sciences/College of Engineering held in Chapel Hill, North Carolina on March 7-9, 1988), Dr. Rob Elias from the U.S. EPA Environmental Criteria and Assessment Office presented a paper titled "Alternatives to the Removal of Lead-Contaminated Soil" in which soil mixing was discussed as a potential option for remediation of lead-contaminated soil.

Test Objectives

The purpose of this study is to demonstrate that local conditions at the site allow the utilization of soil-tilling technology to abate the elevated levels of lead in residential soils between 500 ppm and 1,000 ppm to the ROD performance standard of 500 ppm soil-lead, in lieu of excavation and capping. Soil-lead samples will be obtained from test plots before and after tilling to determine the implementability of this technology. If the data indicate that tilling reduces the concentrations of surface soil-lead to 500 ppm or less, then the technology will be deemed to be technically feasible and acceptable to attain the ROD performance standards at this site.

Pilot Scale Protocols

Field Tilling Protocol

The evaluation of the tilling technology will require the establishment of test plots in a representative residential area where soil-lead values are between 500 ppm and 1,000 ppm. Additionally, to determine the potential limits of soil-tilling to abate elevated soil-lead values, a couple of test plots will be identified with lead concentrations greater than 1,000 ppm. Tilling will be conducted in these test plot areas with surface (0" - 3") samples obtained before and after the blending of the soils. The following is the field tilling protocol to implement the pilot scale study.

* Fifteen representative residential area plots of 15' by 15' will be selected for the study and they ideally will exist in one common location such as a park. These areas will have soil-lead samples obtained at the following intervals: 0"-3"; 4"-6"; 7"-12"; 13"-18" and 19"-24" levels, after the removal of the vegetative layer, using a hand auger. These samples will be analyzed to determine the concentrations of total lead.

* The fifteen test plots will be divided into three sets. Each set of five representative test plots will be tilled to a depth of either: 12", 18", or 24". These three sets of varyingly tilled depth plots will allow one to observe the benefits of deeper tilling in the attainment of the performance standard.

* A survey of different types of tilling equipment will be performed to determine the most applicable type of tiller or combination of mixing/blending equipment for the soil conditions at the site.

* A rototiller and/or other comparable tilling equipment will be used to mix/blend soils to a depth of approximately 12", 18" or 24" below the surface of the soil matrix in each set of test plots. This will manifest a mixing of soils, thereby potentially reducing the soil-lead concentrations in the surface soil horizon. Continual passes of the tiller and/or comparable tilling equipment will be made until there is uniformity of the soil within the test plot. Soil will be recontoured, adding soil as necessary, to meet the original grade.

* After completion of soil mixing/blending, nine representative soil samples will be collected from a depth of 0"-3" below the ground surface within each test plot. These samples will determine if the soil meets the ROD performance standard of 500 ppm by using the null hypothesis - there is no difference between surface soil-lead concentrations and the performance standard. Additionally, a representative soil sample from a depth of 4"-12", 13"-18" or 19"-24" below the ground surface will be collected from the same sample locations as the above surface sample depending upon the tilling depth of the test plot.

* Test plots will be sodded with grass after the study is completed in each plot. A few general soil samples will be analyzed for physical parameters to determine if soil conditioning is necessary to promote long-term vegetative growth. The type of vegetative cover will be selected to promote long-term growth.

* If a majority of test plots, within either variant depth set of plots, indicate that tilling decreases surface soil-lead levels below 500 ppm, then the technology will be deemed as technically feasible and acceptable to attain the ROD performance standards at this site. The exact tilling technique or techniques which will be used as the final tilling remedial action will be based upon the results from the three different set of variant depth test plots. It may be possible that under certain remedial action scenarios that tilling to a depth of 12" is appropriate, while another scenario would require tilling to a greater depth to attain the performance standard.

* Three test plots will be selected with soil-lead levels above 1,000 ppm. Two plots will have soil-lead levels between 1,000 ppm and 2,000 ppm; with one plot tilled to a depth of 18" and the other tilled to a depth of 24". One plot will have soil-lead levels between 2,000 ppm and 4,000 ppm tilled to a depth of 24". These three test plots will be sampled and analyzed using the same protocols and criteria as described above to define the limits of tilling to abate elevated lead concentrations in soil.

Sampling Plan

All samples shall be collected using a decontaminated hand auger with a plastic insert sleeve. Each insert sleeve core shall be capped and numbered for analysis. No preservative shall be added to the samples.

Analytical Methods

Soil samples shall be collected in the form of a soil core. These cores shall be analyzed by on-site and/or off-site X-Ray Fluorescence (XRF) to determine total lead concentrations. The XRF analysis will be conducted by either in situ testing or the testing

of prepared samples. XRF instruments will be calibrated according to standard QA/QC procedures. The attached EPA reference document - EPA Environmental Response Team draft Quality Assurance Technical Information Bulletin for Portable X-Ray Fluorescence will be used in the conduct of XRF measurements.

Data Management

Standard documentation techniques shall be used in the collection of data.

Data Analysis and Interpretation

Standard techniques shall be used to reduce raw data to a useful form.

Health and Safety

The Remedial Design Investigation - Health and Safety Plan shall be modified as needed to account for waste handling and on-site testing operations.

Residuals Management

There are no anticipated residual wastes to be managed under the tilling technology.

Report

A draft and final report will be developed that will include: results of pilot scale protocols; economic analysis of the alternative; and an evaluation of the alternative using the National Contingency Plan threshold and primary criteria.

Attachment

**ATTACHMENT A**

**St. Louis Lead Recyclers
Comments on Documents
Related to NL Industries/
Taracorp Site, Granite City, Illinois**

U.S. EPA Proposed Plan

1. Page 2, Paragraph 2, Sentences 1 and 3

Although St. Louis Lead Recyclers (SLLR) leased the building from Trust 454 and begin installing equipment in August, 1980, and accepted limited quantities of waste pile material starting in July 1981 for process development purposes, SLLR did not start full-scale recycling of lead waste from the Taracorp pile until April, 1982; SLLR shut down all operations due to a contractual dispute with Taracorp on March 21, 1983.

2. Page 3, Paragraph 3, Sentences 3 and 4

The volumes and lead content of the piles on Trust 454 property are incorrect. A recent survey conducted for SLLR by SMS Engineers (See Exhibit 1) found that there are 3,640 cubic yards of rubber chips and 416 cubic yards of slag and mattes on Trust 454 property. Samples of the rubber chips, slags, and matte were analyzed for EP Toxic and total metals. In addition, a sample of each material was analyzed for the TCCP list of parameters, reactivity, and corrosivity. The total lead content of the battery chips varied from one percent to four percent. The slag and matte continued from four to fifteen percent and 0.3 to 0.35 percent respectively (see Exhibit 2, Table 1 for a summary of the analytical results). The lead content in these results are an order of magnitude lower than the results reported in the Proposed Plan as well as the RI and FS reports.

3. Page 3, Paragraph 5, Sentences 3 and 5

Same as comment number 2. In addition, the unpaved area is reported as having a surface lead concentration of 9,250 mg/kg. This is a misleading statement implying that the lead content of surface soil throughout the Trust 454 property is 9,250 mg/kg. However, since the soil sample that contained that high concentration was collected near the edge of rubber chip pile 3, it should not be used to reflect the lead content of Trust 454 surface soil as a whole. As our sampling results indicate the lead content of the surface soils on Trust 454 property (SS-1 through SS-4) (See Exhibits 2, Tables 1 and 2) varies from about 1,000 ppm in the southeast corner of the site to 9,540 ppm near the rubber chip pile. In addition, the



found to increase and decrease with depth (See Exhibit 2, Table 3). Four excavations (EX-1 through EX-4) were sampled on Trust 454 property. One of these excavations revealed an 18-inch thick layer of broken battery casing and slag material. Also, the results indicate that although the lead content tends to vary with depth and some increase with depth is observed, it rapidly and uniformly falls to low levels as a clay layer is encountered at about one to two feet depth (See Exhibit 3). This initial increase in lead content could reflect historic waste disposal by previous occupants as the layer of broken battery casings found in EX-1 seems to indicate.

Feasibility Study Report

5. Page 5, Section I.3.3, Paragraph 2, Sentences 2 and 3

See Comment #3.

6. Page 6, Section 1.3.3, Paragraph 1, Sentence 1

See Comment #3.

7. Page 6, Section 1.3.3, Paragraph 1, Sentence 4

The Consent Decree signed by IEPA and SLLR required a number of actions by SLLR to control fugitive dust (including paving) upon recommencement of any lead waste recycling activity. SLLR applied asphalt material to the gravel road in compliance with the Consent Decree. However, since SLLR has not recycled any lead waste since March 1983, the asphalt has not been reapplied.

- Exhibit, Page 5-30, Section 5.9, Paragraph 2, Sentence 2

See Comment #2 regarding lead content of the ebonite (rubber chips).

Exhibit 1
Site Topographic Map

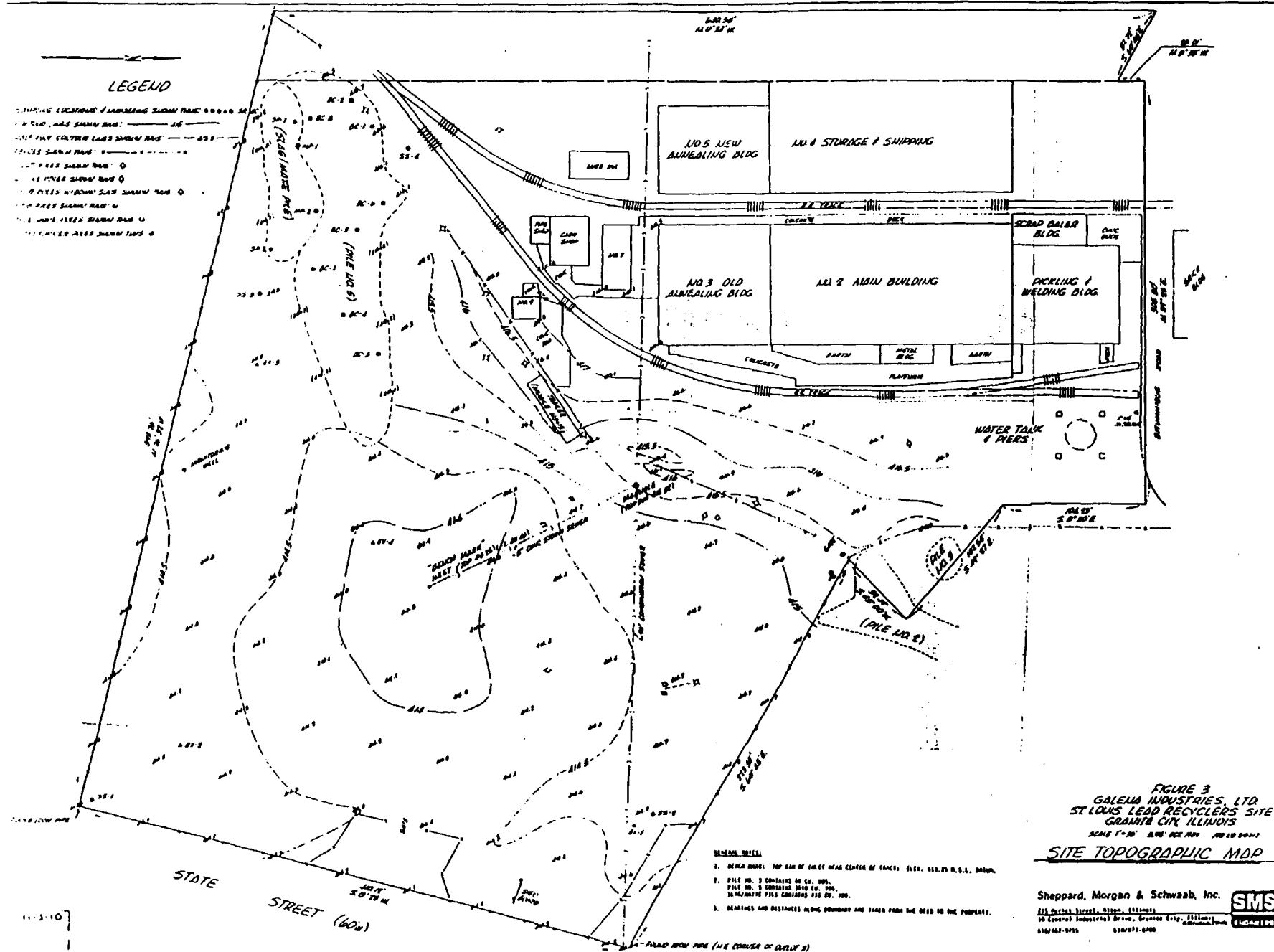


Exhibit 2
Summary of Soil and Wastepile Analyses

WASTE PILE AND SOIL CHARACTERIZATION DATA - INORGANIC ANALYSES 2(MG/KG)

[illegible]

TABLE 1 (CONTINUED)
WASTE PILE AND SOIL CHARACTERIZATION DATA - INORGANIC ANALYSES (MG/KG)

Parameter	BC-1 (5811)	BC-2 (5812)	BC-3 (5813)	BC-4 (5814)	BC-5 (5815)	BC-6 (5816)	BC-7 (5817)	BC-8 (5818)
Ag	<0.85	1.04	<0.75	0.92	<0.85	<0.85	<0.85	<0.70
As	798.7	398.2	252.3	724.4	250.4	280.4 (33.5)	178.0	143.4
Ba	73.7	189	134	75.8	70.9	66.8	161	88.1
Cd	1.5	1.2	3.1	7.2	1.6	2.4	4.1	2.1
Cr	5.8	8.0	8.2	8.8	10.2	5.6	33.0	7.4
Hg	0.21	0.25	0.38	0.65	3.95	0.22	0.26	0.18
Pb	22,600	10,600	21,900	42,700	24,200	32,100	27,900	14,600
Se	<2.72	2.65	3.13	<1.93	3.30	<2.72	<2.72	<2.22
Ag (EP)	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
As (EP)	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Bs (EP)	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250	<0.200
Cd (EP)	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Cr (EP)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg (EP)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Pb (EP)	70.60	49.50	0.942	46.30	28.60	123.00	76.60	27.2
Se (EP)	0.221	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Corrosivity	NR	NR	6.48	NR	NR	NR	NR	NR
Reactivity - CN	NR	NR	NEG	NR	NR	NR	NR	NR

TABLE 1 (CONTINUED)
WASTE PILE CHARACTERIZATION DATA - INORGANIC ANALYSES 2(MG/KG)

Parameter	BC-1 (5811)	BC-2 (5812)	BC-3 (5813)	BC-4 (5814)	BC-5 (5815)	BC-6 (5816)	BC-7 (5817)	BC-8 (5818)
Reactivity -	NR	NR	NEG	NR	NR	NR	NR	NR
Ag (TCLP)	NR	NR	<0.050	NR	NR	NR	NR	NR
As (TCLP)	NR	NR	<0.027	NR	NR	NR	NR	NR
Ba (TCLP)	NR	NR	<0.361	NR	NR	NR	NR	NR
Cd (TCLP)	NR	NR	<0.020	NR	NR	NR	NR	NR
Cr (TCLP)	NR	NR	<0.010	NR	NR	NR	NR	NR
Hg (TCLP)	NR	NR	<0.0002 (<0.0002)	NR	NR	NR	NR	NR
Pb (TCLP)	NR	NR	173	NR	NR	NR	NR	NR
Se (TCLP)	NR	NR	<0.200	NR	NR	NR	NR	NR

TABLE 1 (CONTINUED)
WASTE PILE AND SOIL CHARACTERIZATION DATA - INORGANIC ANALYSES 2(MG/KG)

Parameter	SS-1 (5799)	SS-1 SUB (5800)	SS-2 (5801)	SS-2 SUB (5802)	SS-3 (5803)	SS-3 SUB (5804)	SS-4 (5805)	SS-4 SUB (5806)	MP-1 (5807)	MP-2 (5808)	SP-1 (5809)	SP-2 (5810)
Hg (EP)	<0.0002	<0.0002 (<0.0002)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Pb (EP)	0.412 (0.418)	<0.066	9.150	74.00	2.470	13.40	1.110	1.110	0.449	1.630	1,192.0	378.0
Se (EP)	<0.200 (<0.200)	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200	<0.200
Corrosivity	NR	NR	NR	NR	NR	NR	NR	7.00	9.53 (4.50)	9.46	6.75	NR
Reactivity - Cn	NR	NR	NR	NR	NR	NR	NR	NEG	NEG	NR	NEG	NR
Reactivity-S	NR	NR	NR	NR	NR	NR	NR	NEG (NEG)	NEG	NR	NEG	NR
Ag (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.050 (<0.050)	NR	<0.050 0.329	NR
As (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.200 (<0.200)	NR	<0.050 0.329	NR
Ba (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.250 (<0.250)	NR	<0.7746	NR
Cd (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.020 (<0.020)	NR	<0.020	NR
Cr (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.100 (<0.100)	NR	<0.100	NR
Hg (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.0002	NR	<0.0002	NR
Pb (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.100 (<0.100)	NR	980	NR
Se (TCLP)	NR	NR	NR	NR	NR	NR	NR	NR	<0.200 (<0.201)	NR	<0.200	NR

Notes: EP = EP toxicity extraction; TCLP = TCLP extraction. () = duplicate

TABLE 2

ORGANIC RESULTS - WASTE PILE CHARACTERIZATION (TCLP)

<u>Parameter</u>	<u>Sample Concentration (PPB)</u>		
	<u>MP-1</u> <u>(5807)</u>	<u>SP-1</u> <u>(5809)</u>	<u>BC-3</u> <u>(5813)</u>
<u>Herbicides¹</u>			
2,4-Dichlorophoxyacetic Acid (2,4-D)	<0.17	<0.17	<0.17
2,4,5-TP Silver	<0.043	<0.043	<0.043
<u>Pesticides</u>			
Lindane	<0.003	<0.003	<0.003
Endrin	<0.028	<0.028	<0.028
Methoxychlor	<0.153	2.9	<0.153
Toxaphene	<0.357	<0.357	<0.357
Chlordane	<0.071	<0.071	<0.071
Heptachlor	0.025	0.008	0.013
<u>Semi-Volatile Compounds</u>			
Bis(2-chloroethyl)ether	ND	ND	ND
Cresols(and cresylic acid)	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND
Nitrobenzene	ND	ND	ND
Pentachlorophenol	ND	ND	ND
Phenol	ND	ND	ND
Pyridine	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND

NOTE

¹ Herbicides could not be run using TCLP protocol due to significant interferences. Therefore, herbicide concentrations are reported on EP Toxicity extractions.

ND = Not Detected

TABLE 2
ORGANIC RESULTS - WASTE CHARACTERIZATION (TCLP)
(continued)

<u>Parameter</u>	<u>Sample Concentration (PPB)</u>		
	<u>MP-1</u> <u>(5807)</u>	<u>SP-1</u> <u>(5809)</u>	<u>BC-3</u> <u>(5813)</u>
<u>Volatile Compounds</u>			
Acrylonitrile	ND	ND	ND
Benzene	ND	10.85	ND
Carbon Disulfide	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND
Chlorobenzene	ND	ND	ND
Chloroform	ND	4.21	ND
1,2-Dichloroethane	ND	ND	ND
1,1-Dichloroethylene	ND	ND	ND
Isobutanol	ND	ND	ND
Methylene Chloride	12.74	14.93	3.49
Methyl ethyl ketone	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND
Tetrachloroethylene	1.93	5.55	ND
Toluene	25.47	55.94	4.42
1,1,1-Trichloroethane	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND
Trichloroethylene	ND	3.93	ND
Vinyl Chloride	ND	ND	ND

NOTE:

ND = Not Detected

TABLE 3
SUMMARY OF EXCAVATION ANALYTICAL RESULTS

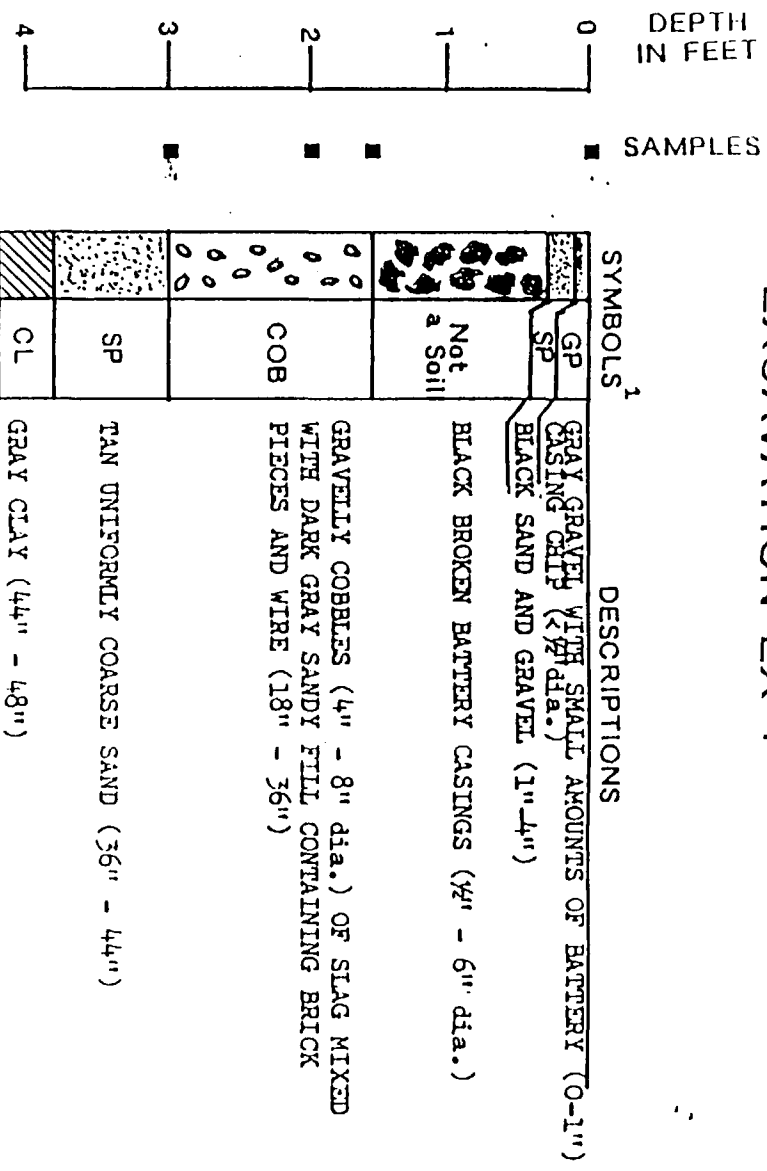
<u>Site Identification</u>	<u>Depth of Sample</u>	<u>Total Lead Concentration (mg/kg)¹</u>
EX1	0"	3,310
EX1	18"	57,400
EX1	24"	701
EX1	36"	1,660
EX2	0"	988
EX2	12"	<11.4
EX2	18"	50.9
EX3	0"	8,880
EX3	12"	15,000
EX3	18"	<17.2
EX4	0"	2,200 (1,750)
EX4	12"	1,220
EX4	18"	11.9

Notes:

¹mg/kg = ppm
() = duplicate

Exhibit 3
Excavation Logs

EXCAVATION EX-1



EXCAVATION EX-2

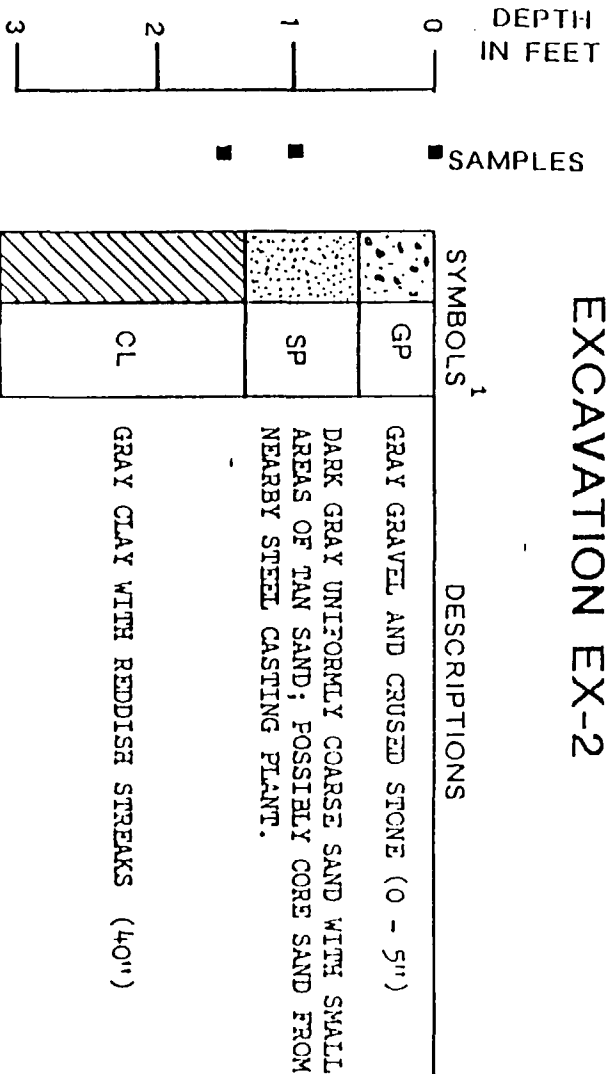


FIGURE 1A

EXCAVATION LOGS

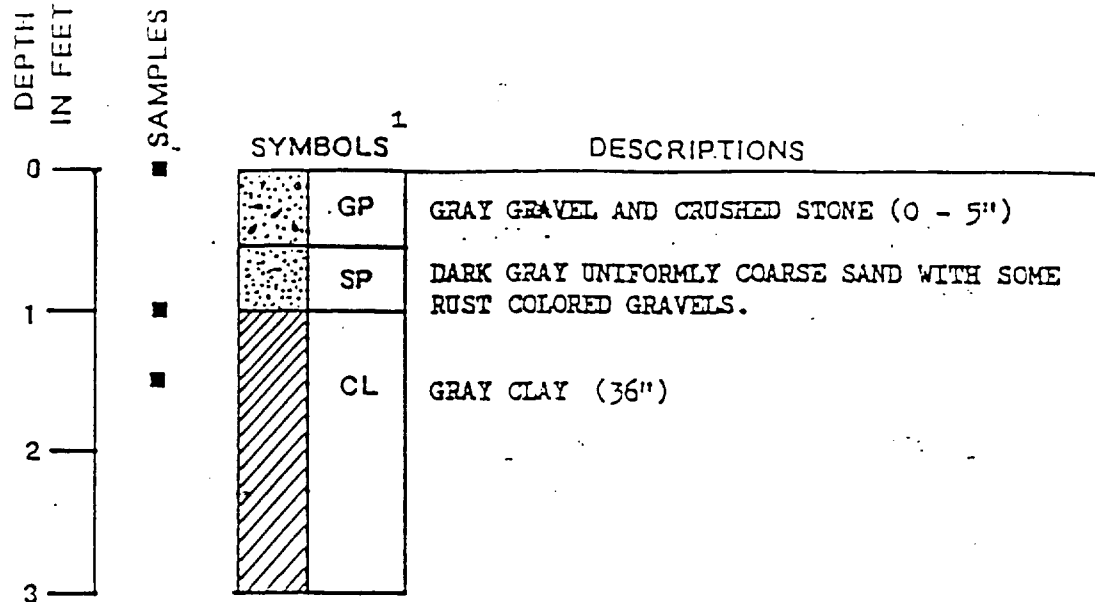
ST. LOUIS LEAD RECYCLERS

Granite City, Illinois

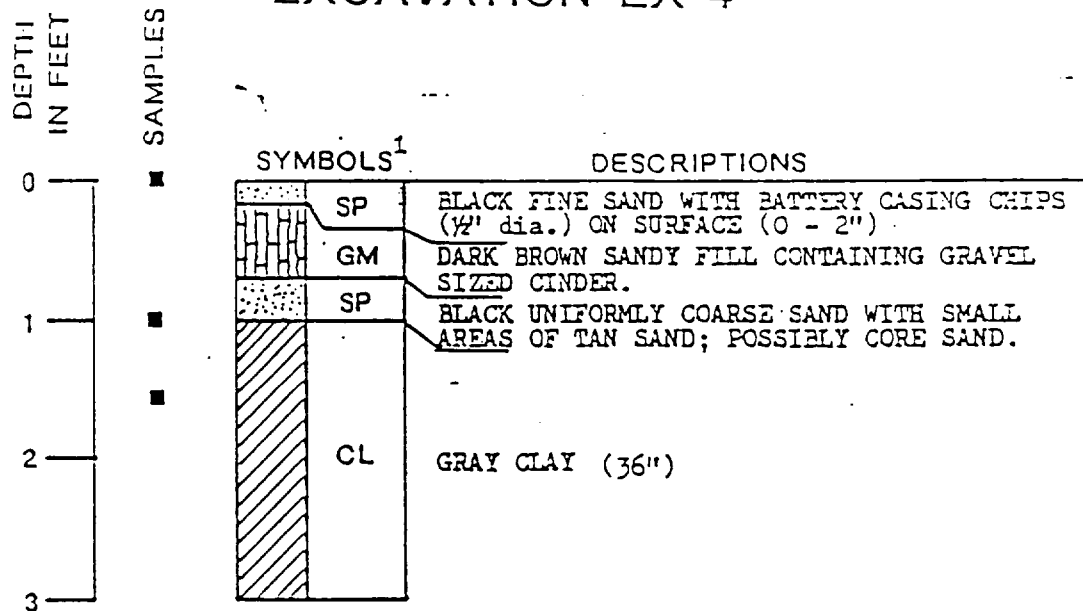
Dames & Moore

- United Soil Classification System
- Samples collected with clean trowels from face of excavation.

EXCAVATION EX-3



EXCAVATION EX-4



¹ United Soil Classification System

■ Samples collected with clean trowels from face of excavation.

FIGURE 1B

EXCAVATION LOGS

ST. LOUIS LEAD RECYCLERS
Granite City, Illinois

Dames & Moore



DAMES & MOORE

A PROFESSIONAL LIMITED PARTNERSHIP

11701 BORMAN DRIVE, SUITE 340, ST. LOUIS, MISSOURI 63146
(314) 993-4599 FAX NO. (314) 993-4895

August 31, 1990

Mr. George Von Stamwitz
Armstrong, Teasdale, Schlafly, Davis & Dicus
611 Olive Street, Suite 1900
St. Louis, MO 63101

**RE: Comments on the Response to Special Notice Letter to
USEPA and Scope of Work
Dames & Moore Job Number: 19076-003-045**

Dear George:

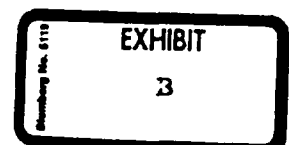
Herewith are the Statement of Work and comments on the subject letter. The activities described in the Statement of Work can be summarized as follows:

- o Removal of the rubber chip, slag, and matte waste piles from the Trust 454 property and consolidation into the NL/Taracorp pile.
- o Excavation of the top six inches of soil from underneath the rubber chip, slag, and matte waste piles including a 10-foot buffer zone and area between the piles and the SLLR facility entranceway. Replacement with clean fill or gravel.
- o Preparation of work plans including health and safety plan.
- o Air monitoring during remedial activities for worker and community health and safety.
- o Oversight of contractor and preparation of final report.

We estimate that the remedial action described above will cost approximately \$84,000.

Also, per your request, we estimate that effect of SLLR's recycling activities and the proposed remedial action will slightly decrease the overall volume of the large wastepile. We compared estimates of the amount of recycled material to the volume of soil proposed for excavation. Approximately 2025 yd³ of lead, lead oxide and plastic were removed from the large wastepile and recycled. This compares to approximately 750 yd³ of soil to be excavated.

From Jim Stack's observations, as much as 8300 yd³ of pile material (unexpanded from transport) was removed from the Taracorp pile. We believe milling and recycling reduced this volume significantly, but it is difficult to quantify. The total volume of material (waste pile and excavated soil) to be returned to the Taracorp pile under this scenario is 4810 yd³.





Mr. George Von Stamwitz
Armstrong, Teasdale, Schlafly, Davis & Dicus
August 31, 1990
Page - 2 -

Consistent with the enclosed Statement of Work we also recommend the following modification to your draft letter to USEPA dated August 22, 1990:

We recommend adding at the end of paragraph 3 that it is estimated that up to 95% of the lead was removed from the material taken from the NL/Taracorp pile.

We recommend modifying paragraph 6 to indicate that the top six inches of soil will be excavated and consolidated (along with the chip, matte and slag piles) with the NL/Taracorp wastepile. It should be also noted here that although the ROD calls for excavation of any soil (in Area 1) with a lead content above 1000 ppm, SLLR believes that for various reasons related to limited SLLR activities at the Site (listed below) that the major source of lead in Site soils is the former smelter operations and that SLLR's contribution to lead in soils is minimal. For this reason removal of the top six inches of soil is a fair contribution by SLLR to the overall remedy at the Site.

Although there are no data that we are aware of that would allow us to quantify SLLR's contribution to the lead observed in soils, there are several reasons for concluding that SLLR's contribution to lead in Site soils was minimal; these include:

1. Excavation of soils at the Trust 454 property (see February 22, 1990 RCRA Closure Plan) indicates the smelter activities reached into the Trust 454 property as evidenced by the presence of an 18-inch layer of broken battery casings, grid lead and slag pieces found on the property. The extent of this layer of debris is unknown. Information describing the full scope of past NL activities on what is now Trust 454 property is unavailable.
2. We believe smelter "fallout" or deposition resulting from airborne fugitive or point source emissions from the smelter and related operations contributed to substantial surface and subsurface soil contamination at the site and in residential areas bordering the Taracorp/NL facility; the result of over 90 years of NL/Taracorp operations. SLLR's "outside" activities, including transport and sorting of the wastepile material and cleaned rubber chips, had limited impact because such activities were of very brief duration, compared to smelter activities (one year versus 90 years of operation, respectively).
3. The lead remaining on the rubber chips in the chip pile would not be leached in significant quantities by rainfall since the most of the leachable lead has already been removed through SLLR's battery waste recycling process includes rigorous contact with proprietary cleaning solutions. It is estimated that as much as 95% of the lead from the wastepile material was removed and recycled.

For these supporting reasons, then, a restoration of the site to its pre-SLLR condition entailing soil removal should be satisfactory to EPA that SLLR has made a substantial contribution to countering its actions during the time of operation.



DAMES & MOORE

A PROFESSIONAL LIMITED PARTNERSHIP

Mr. George Von Stamwitz
Armstrong, Teasdale, Schlafly, Davis & Dicus
August 31, 1990
Page - 3 -

Should you have any questions or require further information, please do not hesitate to contact me.

Very truly yours,

DAMES & MOORE
A Professional Limited Partnership

Neil J. Jost
Associate

NJJ/ken
[njj/vons0828.ltr]

**EXHIBIT B****ST. LOUIS LEAD RECYCLERS' STATEMENT OF WORK****1.0 Introduction**

This Statement of Work (SOW) describes in general terms the activities for remediating certain lead-bearing materials proposed by St. Louis Lead Recyclers (SLLR) for the NL/Taracorp site located in Granite City, Illinois.

2.0 Background

The SLLR facility operated between May 1982 and March 1983 as a recycler of lead from the adjacent NL/Taracorp slag/battery waste pile. This waste pile was placed on the National Priorities List of Superfund Sites on June 10, 1986. The Record of Decision for the NL/Taracorp Site was issued by USEPA in January 1990. This ROD called for the excavation of lead-contaminated materials and consolidation with the NL/Taracorp waste pile under an impermeable cover. This SOW was developed using this remedy as a basis.

SLLR removed approximately 11,000 tons of material from the Taracorp/NL Industries waste pile, and returned about 5,400 tons as unrecyclable slag, matte and trash. The remaining 5600 tons was then processed by SLLR which returned approximately 230 tons of elemental lead and 2800 tons of lead oxide (a generic term that refers to a mixture primarily composed of lead dioxide and lead sulfate). It is estimated that as much as 95% of the lead was removed from the processed material.

The hard rubber chips that exited the SLLR process were accumulated over the approximately seven (7) months of operation in a pile placed on Trust 454 property (see Figure 3). Recent measurements by a surveyor indicated that there are 3640 cubic yards of rubber chips and 416 cubic yards of slag and matte.

3.0 Proposed Action

It is proposed to remove the rubber chip, slag, and matte waste piles from the Trust 454 property and consolidate them into the NL/Taracorp pile. The top six inches of soil will be removed from underneath the rubber chip, slag, and matte waste piles including a 10-foot buffer zone, and an area between the piles and the SLLR facility's west entrance. Approximately 750 yd³ of soil will be excavated. The excavated areas will be backfilled with clean soil and reseeded. Dust control measures and air monitoring will be implemented during the excavation to ensure worker and community health and safety.

A detailed work plan including health and safety plan will be prepared.

All construction work will be overseen by an independent engineer who will prepare a final report.

MORGAN, LEWIS & BOCKIUS

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DIAL DIRECT (215) 963-5555

January 18, 1991

Mr. Steven Siegel
Office of Regional Counsel
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

Mr. Alan Held
Environmental Enforcement Section
Department of Justice
Room 1541
10th and Pennsylvania Avenue NW
Washington, DC 20530

Mr. Brad Bradley
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

Re: NL Industries/Taracorp Granite City, Illinois

Dear Gentlemen:

I would like to make a correction to yesterday's letter. In my haste to get the letter out, I accidentally omitted two parties from the list in the first paragraph. The proposal was also made on the behalf of AT&T and Federal Cartridge.

Thank you.

Very truly yours,


David G. Butterworth

DGB/cmb

SIDLEY & AUSTIN

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January 18, 1991

BY TELECOPY AND MESSENGER


Steven Siegel, Esq.
Office of Regional Counsel
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Re: Granite City Site--Response to 106 Order

Dear Steve:

Please accept the letter dated January 17, 1991 by David Butterworth as the response of the parties on Exhibit A to the Unilateral Administrative Order.

Very truly yours,



Dennis P. Reis

Enclosure

cc: Brad Bradley
Allen Held

WGD91A17.URC (1/18/91 12:47pm)



MORGAN, LEWIS & BOCKIUS

Steven Siegel
Alan Held
Bill Bradley
January 18, 1991
Page 2

cc: Sandra Conner
Daniel Bicknell
Mark Hester
Mark Maxwell
Joseph Nassif
Alan Schlesinger
Judy McCarthy
Janet Smith
Steven Tasher
Stuart Williams

EXHIBIT A

Participants to Response to 106 Order

NL Industries
Johnson Controls (for Globe Union)
AT&T
Exide Corporation (for ESB and General Battery Corporation)
Allied-Signal Inc. (for Prestolite)
Philipp Brothers, Inc.
Federal Cartridge Corporation
Chemetco
Alter Trading Corporation
Madewell & Madewell
General Motors
Morris Tick, Inc.
Sol Tick & Co.
Ford Motor Company

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January 17, 1991

TELECOPY

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Department of Justice
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Washington, DC 20530

Mr. Brad Bradley
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

Re: NL Industries/Taracorp Granite City, Illinois

Dear Gentlemen:

Thank you for meeting with us on January 15, 1991. We would like to emphasize that the PRPs seriously desire to settle their potential liabilities and effectuate an expeditious and protective remedy at the NL/Taracorp, Granite City Superfund Site. We are hopeful that mutually acceptable terms can be defined to enable a settlement between EPA and the potentially liable parties. We believe that we may be able to achieve a global settlement and make the following proposal. This proposal is made on behalf of the following companies: NL Industries, Allied-Signal, Exide, Johnson Controls, General Motors, Phillip Brothers, and Ford.

In order to achieve a global settlement, we have renewed our contacts with NL Industries. We believe that we have reached an agreement in principle, among the generators and NL, and this proposal is premised on the understanding that we will

Steven Siegel
Alan Held
Brad Bradley
January 17, 1991
Page 2

proceed with negotiations to enter into a global consent decree, including NL and generators.

The global settlement is predicated on EPA allowing the PRPs to perform a tilling pilot project that will explore the possibility of using tilling as a possible remedy for areas at the site with soil-lead concentration above 500 ppm. Conversely, if tilling is not considered a global settlement is not possible. Accordingly, we request your comments and response at your earliest possible convenience.

As Mr. Nassif discussed in his January 9, 1990 letter and during our meeting, the consideration of tilling will not delay the implementation of the remedial design. Estimates by the PRPs indicate that the tilling project could be completed during the remedial design phase of the response action. We believe an appropriate and acceptable protocol for a tilling study can be developed that will include a firm timeline so that we can be sure that the project is completed in sufficient time for agency review.

We understand that the agency would require the inclusion of procedures and criteria for review of the tilling study in any consent decree that was entered into. While we understand that the agency would reserve the final decision on the acceptability of tilling, Mr. Nassif's letter may present some useful concepts for structuring the project. We would appreciate the opportunity to explore acceptable options.

If, upon completion of the tilling pilot study, it is determined that tilling is not an acceptable remedy for the Granite City Site, the PRPs would agree to continue with the completion of the remedy as specified in the ROD.

You raised several substantive and procedural concerns with pursuing a study of tilling. Perhaps most importantly, you indicated that EPA does not consider tilling to be protective of public health. The effectiveness of tilling cannot be determined until further study is completed. If tilling reduces concentrations of lead in the soil by a factor of six, or seven, or thirteen, as was the experience of Exide at its Selma, Alabama facility, tilling should be considered an effective remedy.

Tilling is, in fact, a permanent remedy. Once the concentration of lead in the soil is reduced to a point where

Steven Siegel
Alan Held
Brad Bradley
January 17, 1991
Page 3

there is no danger to human health or the environment, that lead will never again present a health threat. Conversely, if the soils are piled at the Granite City Site (or any other place) that pile may continue to be a threat. Considering that lead is ubiquitous and a natural element that cannot be destroyed, tilling may be the only remedy that presents a permanent elimination of the health risks.

Another apparent EPA concern is that tilling has not been selected in a ROD as a remedy at any other site. While our research indicates that this may be true, this cannot be considered an appropriate consideration. Every new remedy will have to be performed for the first time at some site. Tilling should be considered and, if appropriate, implemented at Granite City. The fact that tilling has not been used at other Superfund sites is irrelevant. A tilling study would also present an opportunity to explore, at this time, a new remedial approach, in accordance with the statutory goals expressed in CERCLA. See 42 U.S.C. § 9621(b)(2).

You stated that review of the remedy at this stage could be considered as setting an inappropriate precedent for other sites. Considering that the National Contingency Plan provides for post-ROD modifications, it is clear that such review and alteration of remedial decisions is expected and will be required under certain circumstances. See 40 C.F.R. § 300.825. In the present situation, our proposed study and review of tilling seems warranted for several reasons. First, it appears to be a mechanism by which past procedural and substantive defects in EPA's decision process can be cured to the satisfaction of the parties. This will allow the remedy to proceed now, without the delay, expense and burden of litigation. If the parties litigate, a court may well remand to the agency for further proceedings, resulting, after the expense and delay of litigation, in the same position that the PRPs appear willing to engage in now. See e.g., Rohm & Haas, 669 F.Supp. 672 (D.N.J. 1987).

As we have stated previously, the procedures followed at the this Site have failed to provide Exide and other generator PRPs with the notice and "reasonable opportunity to comment and provide information" that is required by section 113(k)(B) of

CERCLA.^{1/} Nonetheless, it appears that the defects might be cured to the satisfaction of all parties while at the same time proceeding with the remedy.

Your assertions that tilling was not raised in a timely manner as an appropriate remedy for consideration at Granite City should not preclude consideration while the remedial design progresses. During our meeting yesterday we indicated, and you did not disagree, that the generators proposed tilling as a possible remedial alternative during the special notice period. For most of the generators, the special notice letter was the first notice that the ROD had been issued for comment, much less as a final decision document. Accordingly, we raised our position at the earliest time that EPA's notice would allow.

In Rohm & Haas, the parties were afforded much greater notice and opportunity to comment than was afforded in this case. Nonetheless, the court remanded the remedial decision to the agency for further review and directed the agency to include "all potentially responsible parties that the agency intends... to name as defendants." 669 F.Supp. at 684. We see no purpose to be served by having the record remanded for further review. We would prefer to proceed expeditiously with the remedial design and the studies necessary to determine whether tilling will provide a more appropriate remedy for certain areas at this site.

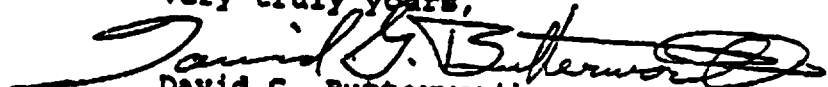
We hope that EPA will seriously consider this opportunity to settle this case. We are ready to act as expeditiously as necessary to effectuate such a settlement. If necessary for purposes of negotiation of the details of this proposal and for organization of PRPs, we would encourage EPA to extend the effective date of the 106 Order.

^{1/} Other significant challenges to EPA's actions exist and have been identified previously. We do not recite them here because the purpose of this letter is to seek settlement and an expeditious implementation of an appropriate remedy.

Steven Siegel
Alan Held
Brad Bradley
January 17, 1991
Page 5

Please call if you have comments or questions. We
would appreciate an expeditious response to this proposal.

Very truly yours,


David G. Butterworth

DGB/cmb

cc: Sandra Conner
Daniel Bicknell
Mark Hester
Mark Kamilow
Joseph Nassif
Alan Schlesinger
Judy McCarthy
Janet Smith
Steven Tasher

Steven Siegel
Alan Held
Brad Bradley
January 17, 1991
Page 6

bcc: Jeffrey A. Leed
Pam Cissik
Timothy Green
Barbara Hink
Dennis Reis

COBURN, CROFT & PUTZELL

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JOSEPH G. NASSIF

REPLY TO ST. LOUIS

February 7, 1991

**Mr. Steven Siegel
Assistant Regional Counsel
U.S. Environmental Protection Agency
5CS-TUB-3
230 South Dearborn
Chicago, Illinois 60604**

**Mr. Alan Held
Environmental Enforcement Section
Department of Justice
Room 1541
10th and Pennsylvania Avenue NW
Washington, D.C. 20530**

Dear Gentlemen:

Following our brief meeting with Mr. Siegel last Thursday, we received EPA's written confirmation that the global settlement proposal has been rejected. We believe this to be unfortunate because from our perspective the global settlement represented a "no lose" position for the agency. Nevertheless, there are still a number of generators who want to pursue settlement further.

As we explained to Mr. Siegel, the original generator carve-out proposal reached an impasse because the agency was unwilling to budge on tilling and the 35% figure for generator participation. We pursued the global proposal because we had no reasonable choice. There did not exist then (nor does there exist now) a sufficient number of generators willing to accept the 35% carve-out without the tilling component. Additionally, we had hoped the global proposal would succeed because both of you expressed a desire for a total resolution. In any event, we could not pursue the carve-out simultaneously because many of the generators and N.L. would have felt this to be acting in bad faith.

Mr. Steven Siegel
Mr. Alan Held
February 7, 1991
Page Two

Following EPA's rejection of the global settlement proposal, we have canvassed again the viable generators regarding a 35% generator carve-out without tilling. Based on our review, we expect more than 60% of the total volume represented by those generators receiving the \$106 order will opt not to participate in the settlement. Many others are still reviewing options with their management. A list of the major non-settling generators and their volumetric percentages is attached for your review. We understand that concerted efforts are being made to convince the undecided generators not to join in any carve-out proposal. As a result, we need to come up with a proposal which recognizes that the settlers will have to pay up to three times their volumetric shares in order to fund the cleanup, but which still makes settlement the most attractive option.

There are two constants in Superfund settlements: protection for good faith settlers and the payment of premiums by non-settlers. In the very likely event that a number of generators will not settle initially, we will need a commitment from EPA that should any non-settler want to settle with you in the future, that a condition precedent to any settlement will be the payment of their portion of the 35% plus interest and a premium. Determining their assessment will not be difficult, and we have a number of options for fixing a premium. This approach gives some assurance to the settlers that at some point, perhaps after the carve-out portion of the cleanup is complete, they have a chance to get reimbursed for their overpayment from all non-settlers. Also, it eliminates a major disincentive to settlement, by demonstrating to all of the generators that ultimately they will have to pay their assessment with interest. The premium is necessary, as otherwise non-settlers may end up in the same or better position than those of us who perform the work. All of the above is consistent with a generator carve-out of this sort and past Superfund settlements.

Because of the large number of non-participants, we will need your help in securing de minimis participation. Without EPA's assistance the de minimis parties will have little incentive to settle because they are under no enforcement order at this point and cannot obtain contribution protection without EPA involvement.

The main aspects of the settlement would be as follows:

- (A) A Generator-Class offer to do 35% of the work with no tilling commitment whatsoever;

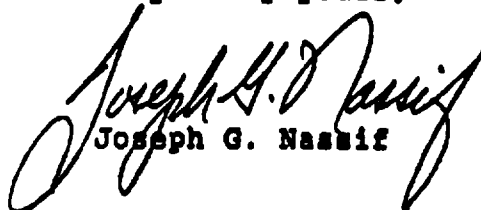
Mr. Steven Siegel
Mr. Alan Held
February 7, 1991
Page Three

- (B) No penalties for those committing to the proposal within five days of an agreement;
- (C) Deferral of past EPA costs and oversight costs unless the agency fails to collect them from non-settlers;
- (D) All de minimis funds go to the benefit of generator settlers and EPA will assist us in collection per the above;
- (E) Contribution protection is provided to all carve-out settlers;
- (F) Government agrees to pursue non-settlers who received the §106 Order, consistent with the conditions to settlement set forth on page 2 of this letter;
- (G) Protection for carve-out settlers in the event of a change or modification to the ROD; and,
- (H) The settling generators would be given first preference as to the tasks to be performed subject to negotiations with EPA.

We believe this approach provides maximum incentive for parties to settle sooner rather than later. Also, it will show those generators who believe that an agreement cannot be fashioned at this point, that an agreement is not only possible, but sensible.

We would like to get your thoughts on whether the above, subject to clarification, is agreeable to the EPA. We need to get something that both sides can live with so that we can begin to lobby those generators who are still on the fence. How soon can you give us a reading on this proposal? Please give me a call.

Very truly yours,


Joseph G. Nassif

Attachment
JGN:lc
28190

N.L. INDUSTRIES, IL

Major Non-Settling Generators Percentage

Johnson Controls	14.69639
Exide (ESB & General Battery)	5.04326
Ace Scrap Metal	3.91678
Allied Signal	2.63965
Sanders Lead	1.69361

28190

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February 11, 1991

VIA TELECOPY AND MESSENGER

Brad Bradley
United States Environmental
Protection Agency
Remedial and Enforcement
Response Branch
230 South Dearborn Street
5HS-11
Chicago, IL 60604

Steven Siegel
United States Environmental
Protection Agency
Trans Union Building
111 West Jackson Boulevard
Third Floor
Chicago, IL 60604

Re: NL Industries/Taracorp Superfund
Site Granite City, Illinois

Dear Brad and Steve:

The United States Environmental Protection Agency ("U.S. EPA") recently issued a unilateral order regarding the Remedial Design/Remedial Action at the site referenced above and extended the effective date until January 18, 1991. Certain parties responded with an offer on January 17, 1991 and requested a further extension, which was denied. At the time, we understood that an answer to the offer would be forthcoming from U.S. EPA shortly. We have now received the answer.

We take this opportunity to reiterate the intention of NL Industries, Inc., Johnson Controls, Inc., Allied-Signal Inc., and Exide Corporation to undertake work at the site immediately. Since the companies' previously stated disagreement with U.S. EPA will not affect the work until the cleanup reaches neighborhoods exhibiting less than 1,000 ppm lead concentrations, U.S. EPA can rest assured that the work will go forward in a timely manner while we continue to sort out our differences. We believe those differences can be resolved within the timeframe necessary to complete the Remedial Design and start the Remedial Action. As part of the Remedial Design phase, the companies also will

Brad Bradley
Steve Siegel
February 11, 1991
Page 2

characterize the surrounding area to 500 ppm as required in your order and do all other planning as if they were cleaning to 500 ppm since the companies were willing to address those areas as part of a compromise offer in any event. We do not view this commitment as an offer. This commitment is a response to U.S. EPA's order requiring the companies to perform. This response is, however, consistent with our previous offers. The companies respond to U.S. EPA's order by unequivocally committing to perform the work in the undisputed areas. Thus, U.S. EPA does not compromise any rights it may have against the companies by permitting work to begin.

Proceeding with the work should benefit both U.S. EPA and other interested parties. We understand that certain PRPs are seeking a carve-out of work at the site. We would work with those parties and U.S. EPA to structure a mechanism for those parties to resolve their liability to the United States. Perhaps a combination of commitments to perform work and cash settlements may be a way to reconcile the goals of the agency and the various PRPs. Those parties which have a relatively small stake in the site would no doubt like to buy out their liability. Permitting these parties to finance ongoing work through a de minimis consent order has merit, and we are willing to support such an effort.

The companies will contact Brad Bradley to set up a meeting so that work can begin within two weeks. In the meantime, if you have any questions or comments, please feel free to call any of the persons listed below.

Yours very truly,

Dennis P. Reis /wgd

Dennis P. Reis

cc: Thomas J. Courtney
Janet Smith
David G. Butterworth
Jeffery A. Lead
Pamela J. Cissik

COBURN, CROFT & PUTZELL

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JOSEPH G. NASSIF

February 15, 1991

REPLY TO ST. LOUIS

**Mr. Steven Siegel
Assistant Regional Counsel
U.S. Environmental Protection Agency
5CS-TUB-3
230 South Dearborn
Chicago, Illinois 60604**

Re: Carve-Out Language

Dear Mr. Siegel:

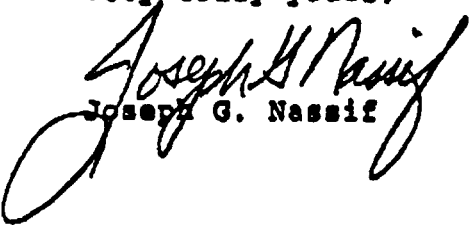
Below is the language we discussed pertaining to the Carve-Out proposal. We are working up a more complete framework which embodies both this language and the Decree which will be delivered to you tomorrow. It might make more sense to simply incorporate these changes into the Decree, rather than use the addendum format.

There may need to be some additional language or changes, but the attached certainly gets you what we discussed. Exhibits B and C can be worked out as part of our additional discussions. We have given you our proposed Exhibit A, which may need some additional clarification. We can do that on Tuesday, if necessary.

All of the above and the enclosure is intended for you to put something together for your management. We have not had a chance to review this with our various managements or with many of the PRPs.

The paragraphs that are numbered are intended to allow you to follow paragraph references in the various clauses.

Very truly yours,


Joseph G. Nassif

**JGN/cn/6544n-100
Enclosure**

COBURN, CROFT & PUTZELL

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JOSEPH G. NASSIF

March 8, 1991

REPLY TO ST. LOUIS

Mr. Steven Siegel
Assistant Regional Counsel
U.S. Environmental Protection Agency
5CS-TUB-3
230 South Dearborn
Chicago, Illinois 60604

Re: Final Carve-Out Proposal: N.L. Industries/Taracorp
Site

Dear Mr. Siegel:

On Thursday, February 21, 1991, Alter Trading, AT&T, Federal Hoffman, Ford Motor Company, General Motors, and Philipp Brothers (hereafter the "Companies") made their final carve-out proposal to you, two aspects of which were unacceptable to the Agency. Thus, three months of intensive effort by these Companies to settle this matter with the Agency ended without a settlement being reached. The purpose of this letter is to document the good faith efforts of these Companies to bring about a settlement, not just on their own behalf, but on behalf of all PRPs. Also, it is important that the Agency understand that these Companies are still very much interested in reaching an agreement and believe that their latest offer should have been accepted by the Agency. The Companies have taken all reasonable steps, as more fully explained herein, to bring themselves into compliance with the Unilateral Administrative Order (the "Order").

The offer that was confirmed during our discussion on February 21, 1991 contained approximately fifteen points; the Agency and the Companies were able to reach an agreement on all but two of these points. The latest offer of the Companies would have had the settling customers,¹ who by volumetric

¹ As stated herein, the Companies canvassed all of the customers receiving the Order to assess interest in their proposal. The 40% figure set forth herein is based on the informal canvassing and amounts to a best-case calculation on the number of interested customers. A letter sent to those customers not receiving the Order (deminimus), indicated that there was little, if any, interest among this group to help fund the cleanup.

90-11-3-608

share account for less than 40% of the viable customers receiving the Order, paying 100% of the customer portion of the cleanup. This translates into providing remedial design and remedial action work with a value of \$10,200,000 towards a total estimated cleanup of \$29,200,000 or 35%. Essentially settling customers who, by volume, account for less than 15% of the total responsibility for the overall site cleanup have agreed to perform 35% of the project.² It is extremely unfortunate that the Agency rejected this proposal.

During our February 21, 1991 phone conversation, the Companies advised you that they could not agree to two changes to their proposal, which you intended to circulate for Agency approval. The first change you were going to propose, i.e., funding the Remedial Design Investigation ("RDI") in addition to 35% of the remedial work, was rejected by the Companies because it would increase the cost of this proposal to the settling customers by \$1,200,000 and would push their share of the carve-out beyond 35%. This was totally unacceptable, particularly in light of the small number of interested customers. The second unacceptable change had to do with your insistence that the Companies excavate in and around the residences near the N. L. Industries/Taracorp site. This would have a small number of customers doing all the prep work, all the mobilization, all the public relations work for a relatively small percentage of the residential cleanup (less than 15%). Any moneys spent on these items would be in addition to the settling customers' share of the project (35%). The Companies proposed substituting cleanups of the alleys and a cash payment, a far less complex, less disruptive, and more cost effective option; however, the Agency rejected the Companies' alternative. The sense that came out of the negotiations is that the Agency is looking for some part of the residential work to be done in order to bolster its litigation posture.

This small group of customers has tried to forge a settlement under the most difficult of circumstances. Up until December 7, 1990, there had been across-the-board rejection by all PRPs of the residential cleanup level and remedy. The

² The interested customers comprise 40% of the viable customers receiving the Order. Under this proposal, the customers' share of the total cleanup was 35%. In terms of overall responsibility for the cleanup, the interested customers represent 14% (35% x 40%) by volume of those receiving the Order.

Mr. Steven Siegel
March 8, 1991
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cleanup level was rejected because there was not sufficient data to show a relationship between soil-lead levels above 500 ppm and blood-lead levels in the Granite City residents living near the site. The 500 ppm cleanup level for residential areas is not based on science or fact. The fact that a major blood-lead study is being planned for the area by the State of Illinois, after the cleanup value has already been set, is proof that there is serious question about the relationship of the ROD cleanup values and legitimate public health concerns. As the Agency knows, the customer PRPs early on proposed a blood-lead study for the very reason stated above. The customers have always been willing to accept the ROD cleanup levels so long as they are justified by a competent study.

Despite the firm belief of these Companies that a study needs to be done before a cleanup value is set, they proposed on December 7, 1990 in your offices that a carve-out take place separating the customers' share of the cleanup from that of the owner/operators. They presented various rationales for where the line should be drawn between the owner/operators' share and that of the customers. Their original proposal included a sliding scale based upon the number of customers participating. The sliding scale would have protected the customers from paying too great a premium in the event that a large number of customers decided not to settle. From the beginning, these Companies told you that this was a very likely possibility, particularly if the Agency refused to consider tilling as a remedial option as part of the RDI. During the meeting, the Companies proposed a 35% customer share to be adjusted depending upon the number of participating customers. Following the meeting the Companies were told that if the demand for a tilling study was dropped that the sliding scale approach would be more acceptable to the Agency. There was never any outright rejection of the sliding scale approach until your letter of December 24, 1990.

The Agency made it quite clear, both during the meeting on December 7, 1990 and after, that its first desire was a global settlement in order to avoid litigation entirely. The Agency recognized that a global settlement was not likely and stated that in the alternative a carve-out proposal might be agreeable if it included acceptance of the ROD and performance of the RDI. The Department of Justice representative made it very clear that he would prefer not to litigate against both classes of PRPs (customers and owner/operators) if at all possible. The Companies left the meeting believing that the Agency wanted a proposal which included acceptance of the ROD and a customer class resolution accounting for 35% of the work.

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A critical item of agreement during the December 7th meeting was that the settling customers would be able to select the work comprising the carve-out portion. It was understood that first choice of the work would be given to the settlers, subject to revision following completion of the RDI. This was a major incentive to settlement because of the uncertainty and complexity associated with the residential work.

From the beginning, the Companies proposed an approach that would protect them if major customers did not join in the settlement. It was made crystal clear to the Agency that, if there were substantial customers who chose not to settle, residential work would be the first item dropped from the work of the settlers. The very function of the sliding scale proposal was to delete the most uncertain and complex part of the work in the event of significant non-participation. The position of the Companies has never changed as to the interrelationship of customer participation to the degree of performance of residential work.

On December 13, 1990, in a letter to you from Mr. Bicknell, a representative of one of the Companies, the customers proposed doing 35% of the ROD, conditioned only upon the Agency sanctioning a study of tilling as part of the RDI. The proposal did include a sliding scale adjustment based on customer participation consistent with the basic premise discussed at the December 7th meeting. It was believed that this proposal provided the Agency with the elements it was looking for following the discussion of December 7, 1990.

Following the December 13, 1990 letter, on December 21, 1990, a meeting took place involving most of the Order recipients with EPA in your Chicago office. There were several points that were made during the course of the meeting. The Agency indicated very clearly that it was their belief that tilling should have been studied as part of the remedial investigation and feasibility study ("RI/FS"). Also the Agency indicated that it believed it was too late in the process for it to consider tilling. Finally the Agency made the point that tilling should be studied in the future as a remedial alternative at other lead sites.

In response the customers made the point that they did not have the opportunity to participate in the RI/FS, and therefore, they could not be faulted for the fact that the RI/FS did not address tilling. Furthermore, the customers made it clear that tilling could be studied without interfering with the RDI or delaying implementation of the ROD. Towards the end of the meeting the Agency requested information on tilling which was subsequently provided to Mr. Bradley for his review.

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This information included an outline of a tilling study proposed by the customers. During the December 21 meeting and in subsequent conversations with Mr. Williams, a representative of one of the Companies, the inference was made that tilling might be considered by the Agency in the context of a global settlement.

On December 24, 1990, the parties received a letter from you responding to the December 13th proposal. This was the first time the Agency formally rejected the sliding scale (i.e. pro rata share) approach. The Agency stated that it would not accept less than 35% of the remedy being performed by the customer settlers and that tilling was unacceptable as part of a carve-out proposal.

In addition, you identified other issues in your letter that were not mentioned in our correspondence of December 13th or in the December 7th meeting that would "warrant further discussion." One of the remaining issues to be discussed further was whether or not the carve-out group was willing to do the RDI in addition to 35% of the remedial action. In return, the Agency would agree not to include an amount for "other contingencies" when calculating the 35% share. The Agency has stated repeatedly that it believes this to be a fair tradeoff. It is clear from your letter of December 24, 1990, that this issue was going to require "further discussion." There was no agreement then or thereafter that the customers would perform the RDI over and above the 35% share of the remedial action. In any event, the EPA rejected the December 13, 1990 proposal.

During a phone conversation with me on January 2, 1991, you specifically requested that the parties explore ways to get N.L. Industries to the table. We discussed during that conversation that N.L. might be willing to settle if a tilling study was part of the remedial design. You told me that it was unlikely that the Agency would agree to any proposal which included tilling but again expressed interest in a global settlement. We both knew that even with tilling, any agreement with N.L. was unlikely because of the serious cost allocation differences between N.L. and the customers.

Following your December 24, 1990 letter, the Companies, along with almost all of the major viable customers, on January 9, 1991, made a new proposal to perform 35% of the work, which was not contingent on customer participation (no sliding scale adjustment). The only condition to this proposal was that tilling be studied as part of the RDI. This condition was critical to the participation of almost all of the major customers. As the offer was presented, the Agency had control

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of both the design and review of the results of the tilling study. In essence, it was a "no lose" proposition for the Agency. During our meeting of January 15, you acknowledged as much before leaving the room to discuss the matter further with Mr. Bradley and Mr. Giller. In between your letter of December 24th and the response of January 9, 1991, the Companies met and talked with many of the customers to get a sense of their willingness to proceed with the 35% carve-out absent tilling. It was clear that most customers would not go forward with the carve-out absent tilling. The parties told you during the January 15 meeting that there would be little support for a 35% carve-out if tilling was not considered during the remedial design stage. Nevertheless, when you returned to the room, you rejected the January 9th proposal.

Following the meeting on January 15, 1991, it became clear that the only real chance for an agreement was to combine tilling with a global settlement. The Agency had several times expressed a desire that the entire matter be settled and had rejected tilling as part of any customer carve-out proposal. At the same time, the Companies realized that tilling was essential to the participation of N.L. Industries and several of the major customers.

On January 17, 1991, two days after the meeting in Chicago, the parties proposed to you in writing a global settlement which included a tilling study, giving the Agency the control that was discussed in the letter of January 9, 1991. This was the first proposal to include a joint commitment by the major customers and N.L. to perform the ROD. In addition to submitting this global proposal, you suggested that the parties also submit a carve-out proposal without tilling. The parties told you then that submitting any alternative proposal that did not include tilling would have been viewed as bad faith by the parties (N.L., Johnson Controls, Allied, etc.) that are committed to tilling, thus killing any possibility of a global agreement.

As you know, it was a substantial accomplishment to get N.L. to agree to accept the residential cleanup level in the ROD. The only consideration requested in return was that the Agency fairly assess a study of tilling as an alternative remedial option. The Agency had previously acknowledged that tilling should have been considered in the RI/FS. In your letter of February 1, 1991, which rejected the global agreement, you recognized that significant strides had been made to even put the offer together.

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Following rejection by the Agency of the customer carve-out and global settlement proposals which included the tilling study, these Companies (which represent by volume less than 40% of the viable customer PRPs receiving the Order), on February 7, 1991, submitted a new proposal which did not include tilling. The rationale of the Companies for this new proposal was to go forward and perform the entire customer share (35%) of the ROD in return for certain protections which were necessary because of the small number of customers that were interested in settling absent a tilling study. The Companies offered to pay or perform work amounting to \$10,200,000 in exchange for these protections. At a minimum, \$8,600,000 worth of work as described in the ROD would be performed under this proposal, with the remainder being paid in cash. The cash payment could be applied by the Agency or the nonsettlers to the remaining residential work. As discussed above, the Agency changed two elements of the Companies' February 7th proposal.

The Agency proposed that the interested customers perform excavation in and around the residences near the site. The Companies' proposal would have limited the off-site work to cleanup of the alleys in Venice and Eagle Park Acres, without disturbing the residences. Furthermore, the Agency proposed that the interested customers pay \$1,200,000 for the RDI in addition to 35% of the remedial design/remedial action. Although both of these changes have been previously mentioned, some additional explanation may help the Agency understand the position of the Companies on these two points.

From the very beginning of the negotiations, the Agency agreed that the Companies would be able to select the work that would comprise the carve-out. As part of the initial proposal, the Companies requested that the residential work be left to the nonsettlers. The Companies believe that it is consistent with the various equitable elements of CERCLA and CERCLA settlements, that the nonsettling parties bear the risks associated with the residential work. They proposed that any remaining monies following performance of the on-site work could be given to the Agency to be either held in trust or to be applied to future expenses of the Agency. Various alternatives were discussed; however, the actual residential work to be done was never defined in any of the meetings or correspondence and was always tied to customer participation.

The Companies' last proposal included cleanup of the alleys and a cash contribution towards the remaining residential work. As recently as last week the Companies were told that the people of Granite City do not want the residential work to proceed as set forth in the ROD. If this is so, as the Companies believe, commencement of yard excavation, on any

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scale, presents a potential public relations disaster. If there is public resistance to the commencement of excavation in and around the residences, the settling customers would not only bear a substantially disproportionate share of the ROD and RDI costs, but, in addition, all of the public relations, other administrative, and access costs as well.

The Companies have told the Agency that they are willing to agree that in the event Johnson Controls, Exide, and Allied join in the settlement, all of whom have experience in either lead-soil or residential cleanups or both, and, are three of the top four customer contributors to the site, that the Companies will do additional residential work in lieu of a cash payment. You stated that in your opinion Johnson Controls, Allied and Exide would settle if the Companies entered into an agreement with the Agency. The Companies stated that if you are correct, excavation around the residences would be done. Despite your stated beliefs that they would settle and that they are "bluffing", you rejected the proposal of the Companies.

You also stated that it was your firm belief that N.L. Industries would not go forward with the litigation alone. Under the proposal of these Companies if N.L. settled, all of the residential work would be done as set forth in the ROD. However, the Agency still found the final proposal of the Companies to be unacceptable. The nature of these two additional elements, and their limits, underscores the fact that this offer poses very little risk to the government, particularly in light of the government's settlement scenario. If the government's prediction regarding settlement did not take place, the Agency would have \$1,600,000 to apply to the remaining residential work as set forth in the ROD and \$8,600,000 worth of work completed. If the Agency is correct in its settlement scenario, acceptance of the proposal of the Companies would result in a complete resolution and implementation of the ROD, without a study of tilling. The Agency was more than remiss in rejecting this proposal.

The second change proposed by the Agency was the addition of the \$1,200,000 RDI costs on top of 35% of the remedial design/remedial action costs. In the last couple of weeks, the Agency told the Companies that it now believes that the "other contingency" costs, which are described in the ROD but for which a dollar estimate is not given, are three times the RDI costs. After discussions between the technical people representing the Companies and Agency technical staff, the Companies disagree. The Companies' some time ago gave the Agency their estimate that the cost of the other contingencies will not exceed \$150,000 based upon the Agency's description of what they entail. Rather than swap these two items as

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suggested by the Agency, which seems to be eminently unfair to the Companies, the Companies proposed that both items be included in the ROD costs and that they would agree to pay 35% of the total. The other contingency costs would be subject to a more precise estimate following the completion of the RDI and at that time adjustments could be made. Also, the parties would know then the final costs of the RDI. If the original tradeoff represented such a good deal for the Companies as suggested by the Agency, the proposal of the Companies should have been acceptable. The Companies were simply asking to be protected in the event their estimate of the other contingencies turned out to be accurate. The Agency refused the proposal of the Companies because it felt that the other contingencies would not be susceptible to estimation even following the ROD. If this is true, the Companies do not understand how the Agency can even estimate the other contingency costs at the present time. The Companies proposed that in the event of a dispute regarding the other contingency costs this matter could be resolved through the dispute resolution mechanism set forth in the Consent Decree. This too was not acceptable to the Agency.

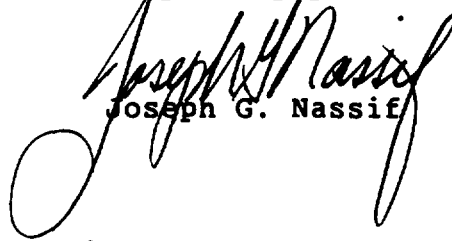
Attached is an exhibit which lays out on a point-by-point basis the two proposals of the Companies. The first proposal indicates what the Companies are willing to do in the event N.L. Industries, Johnson Controls, Exide, and Allied do not join in the settlement. The second proposal lays out what the Companies are willing to do if Johnson Controls, Exide and Allied join in a customer carve-out settlement. As stated above, if N.L. settles, even should Johnson Controls, Exide and Allied not join in the settlement, the Companies are still willing to perform residential work because N.L.'s involvement will insure continuity and the completion of all of the residential work without interruption. The two proposals lay out an impressive amount of cash and work particularly when one considers that less than 40% of the customers by volume are willing to proceed with more than 90% of the customer carve-out portion of the work, providing the remaining ten percent in cash. The alternative proposal would have the Companies doing 100% of the customer carve-out portion of the work. Either of these proposals certainly amounts to a "good faith" effort to comply with the Order. It is regrettable that the Agency refused to accept what the Companies offered.

We would request that this letter along with the following earlier correspondence be made part of the Administrative Record for purposes of any future proceedings: December 13, 1990 letter from Mr. D. J. Bicknell to Messrs. B. Bradley, A. Held and S. Siegel; letter of December 24, 1990 from Mr. S. Siegel to Mr. D. J. Bicknell; letter of January 9, 1991 from

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Mr. J. G. Nassif to Mr. S. Siegel; letter of January 17, 1991 from Mr. D. G. Butterworth to Messrs. S. Siegel, A. Held and B. Bradley; letter of February 1, 1991 from Mr. S. Siegel to Mr. D. Butterworth; letter of February 7, 1991 from Mr. J. G. Nassif to Messrs. S. Siegel and A. Held; the letter plus attachments of February 15, 1991 from Mr. J. G. Nassif to Mr. S. Siegel; the letter plus attachments of February 16, 1991 from Mr. J. F. Warchall to Mr. S. Siegel; and, letter of February 19, 1991 from Mr. D. Bicknell to Mr. B. Bradley.

Very truly yours,



Joseph G. Nassif

Enclosures

cc: Mr. Alan Held
Mr. Rodger Field
Mr. Brad Bradley

01951

NL INDUSTRIES/TARACORP ROD COST ESTIMATION

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (Areas 1-3)	712	\$1,233 Areas 1-8; FS esti
Indirect Capital Costs (45%)	1,032	
Contingency (25%)		
Engineer (15%)		
Legal (5%)		
Bottom Liner	133	FS adj esti
Indirect Capital Cost (45%)	193	
SLLR Pile	109	FS esti
Indirect Capital Cost (45%)	158	
Contained Drosses	6.5	FS esti
Indirect Capital Cost (45%)	9.4	
Area 1	1,663	ROD esti
Indirect Capital Cost (45%)	2,411	
Area 2	1,603	FS esti
Indirect Capital Cost (45%)	2,324	
Area 3 (4,750 CY)	491	CY x \$103.3/CY
Indirect Capital Cost (45%)	712	
Other Costs	1094	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Fence	100	PRP esti
Indirect Capital Cost (45%)	1,586.3	
Blood-Lead Survey	500	EPA revised esti
Alleys-Venice, Eagle Park, etc	748	FS esti 106 w/ 7 fold factor
Indirect Capital Cost (45%)	1,085	
Eagle Park Acres Ditch	1,186	FS esti 118 w/ 10 fold factor
Indirect Capital Cost (45%)	1,719	

Annual O/M	53	FS esti 35
Indirect Capital Cost (45%)	77	For WP&Reports
Present Worth - 30 yr, 5%	1,177	
Air Monitoring	0.5	FS esti
Air Sample Analysis	8	FS esti
Groundwater Sampling	8.5	FS esti 1.8
Groundwater Analysis	14.3	Indi after yr 2
Site Mowing	6.5	FS esti
Site Inspection	2	FS esti
Misc Site Work/Repair	9	FS esti
Site Work Materials	4	FS esti

New Estimates Outside of FS

Area 4 (26,600 CY)	2,748	CY x \$103.3/CY
Indirect Capital Cost (45%)	3,985	
Area 5 (5,560 CY)	393	CY x \$103.3/CY
Indirect Capital Cost (45%)	570	
Area 6 (9,500 CY)	982	CY x \$103.3/CY
Indirect Capital Costs (45%)	1,424	
Area 7 (4,750 CY)	491	CY x \$103.3/CY
Indirect Capital Costs (45%)	712	
Area 8 (34,200 CY)	3,533	CY x \$103.3/CY
Indirect Capital Costs	5,123	
Extra Multi-layer Cap Area	521	FS adj esti
Indirect Capital Cost (45%)	756	
Additional Bottom Liner	534	FS adj esti
Indirect Capital Cost (45%)	774	
Other Costs	940	
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	500	FS esti 40
Equip't Decon	200	FS esti 40
Indirect Capital Cost (45%)	1,363	
Home Interior Inspections	231	\$150/house
Indirect Capital Cost (45%)	335	
Other Contingency Measures		see assumptions
Indirect Capital Cost (45%)	?	
Remedial Design Investigation	1,266	EPA/PRP esti.
Total	29,214.7	

Total Costs do not include Contingency Plans/Measures

Assumptions:

***Bottom liner** - Alternative "E" FS cost estimate for total cost of pile + residential soils liner - \$1,259 X residential soil (98,567 CY) = \$667,270 for liner
resi and pile soils (183,567 CY)

***Residential soils-**

-3" depth removal per FS cost estimate

-62.5% average surface area/block to be excavated per Enroserv Midwest 11/6/90 Report

-160,000 average sq.ft./block per Enroserv Midwest 11/6/90 Report

-950 average CY/block per Enroserv Midwest 11/6/90 Report

-98 total residential blocks in Areas 1 - 8 per Surdex 2/90 aerial photographs

-\$103.3/CY for residential soil remediation, which includes soil removal and replacement, trees/shrub replacement, and pavement cost.

***Monitoring wells-**

-installation - 4 deep wells at 60 ft./well x \$60/ft. = \$14,400

-annual monitoring -

-collection-17 wells x 2 times/yr = 34 samples
x \$250/sample = \$8,500/yr

-analysis-34 samples + QA/QC = [43 samples x \$1,500/HSL analysis = \$64,500/yr x 2 yr = \$129,000/ 2 yr] + [43 samples x \$250/indicator analysis = \$10,750/yr x 28 yr = \$301,000] = \$430,000/30 yr = \$14,300/yr

***Home Interior Inspections -**

-XRF in-house inspection for lead sources (e.g., paint, plaster) at \$150/house (3 hrs/house at \$50/hr) x 1421 houses = \$231,150

***Other Contingency Measures -**

This element was originally generated at the request of EPA and based upon the scenario provided by EPA at a cost of \$104,383, including indirect capital costs the total figure is \$151,000. Outlined below are the assumptions used to craft the EPA scenario constituting Other Contingency Measures.

It should be noted that the 25% contingency component of the 45% indirect capital cost figure applied to Areas 2-8 estimates of residential cubic yards brings the average available surface area to be excavated to about 80% of the residential plot, which is greater than the single highest PRP estimate of any available residential surface area. Additionally, Area 2-8 estimates assume that every residential plot will be remediated; yet one needs to recognize the fact that a significant number of residences included within the Areas 2-8 estimates will not need remediation (i.e., have yards less than the action level of 500 ppm soil-lead). Given these facts, the inclusion of this item is very questionable in the PRP's opinion.

-driveway at average residence = 8' x 30' = 240 sq ft x 1421 houses = 341,040 sq ft

-assume that one out of five houses removes driveway = 341,040 sq ft / 5 = 68,208 sq ft as contingency.

-68,208 sq ft x 3" depth removal of soil = 27,283 cu ft / 27 cu ft/CY = 1010 CY x \$103.3/CY = \$104,383

REVISIONS
TO CONSENT DECREE

- WHEREAS CHANGES -

Whereas the Settling PRPs are agreeable to implementing a portion of the Scope of Work ("SOW") adopted by U.S. EPA in the ROD as set forth in Appendix 2 to this Decree, said portion hereafter referred to as the "Customer Portion"; and

Whereas the Settling PRPs have made a good faith offer in response to the outstanding unilateral administrative order issued by the U.S. EPA under §106 of CERCLA;

- CHANGE TO PURPOSE SECTION -

The purpose of this Decree is to set forth the terms and conditions under which the Settling PRPs can satisfy their obligations under this Decree by performing the Customer Portion of the Scope of Work ("SOW") for the Facility, to remove the Settling PRPs from the provisions of the November 27, 1990, Unilateral Administrative Order issued by the U.S. Environmental Protection Agency ("U.S. EPA") under Section 106 of CERCLA, and, to assure that the Settling PRPs are adequately protected in light of their undertaking to perform the Customer Portion of the SOW.

- ADDITIONAL DEFINITIONS -

"Oversight Costs" means any direct costs not inconsistent with the National Contingency Plan, actually incurred and paid by the U.S. EPA and the State of Illinois, in monitoring the compliance of the Settling PRPs with this Decree, including but

not limited to contractor costs, sampling and laboratory costs, and travel, but excluding indirect costs and any and all interest that accrues prior to the time that this decree is entered.

"Settling PRPs" means the persons, entities, or companies who become parties to the provisions of the Decree within sixty (60) days of the documents being filed with the Court, but does not include Owner Settling PRPs as defined in the Decree.

- CHANGES TO GENERAL PROVISIONS -

2. Commitment of Settling PRPs to Perform SOW.

a. Settling PRPs agree jointly and severally to finance and perform the work as defined in Exhibit A, which reflects 35% of the costs of the work contemplated under the SOW, and to commence said work at the time the Decree is filed with the Court. The commitment of the Settling PRPs to perform the work set forth in Exhibit A shall be null and void in the event that the owner/operator defendants become parties to this Decree and Addendum within the sixty (60) day period as set forth in paragraph 5. Following completion of the RD, certain modifications of the work to be performed by Settling PRPs may be required. Settling PRPs shall revise Exhibit A, if necessary, following completion of the RD, consistent with the provisions of this Decree, and subject to the agreement of the U.S. EPA. In no event shall the work performed by Settling PRPs exceed 35% of the SOW. Any modification to Exhibit A shall be mutually agreed to by the parties. The Unilateral Administrative Order relating to this Facility is modified as

to any Settling PRPs who are hereby removed from the scope and authority of the Order.

b. Consistent with the provisions set forth in Section X (Site Access) and Section XIII (Force Majeure) of the Decree, if access to the Facility or other areas where work is to be performed hereunder is not obtained, despite the best efforts of the Settling PRPs, the United States will thereafter assist the Settling PRPs in obtaining access, to the extent necessary, to perform the work. The United States' costs in this effort and any compensation paid to the property owner shall be considered costs of response, but shall not be reimbursed by Settling PRPs to the extent these costs relate to access to property controlled by the owner/operator defendants.

CHANGE TO: Computation of Time.

Any deadlines pertaining to implementation of the Customer Portion of the SOW are set forth in Exhibit B.

CHANGE TO: Conveyance of the Facility and Institutional Controls.

Paragraph 9 of the Decree, including all subparts thereof, is neither binding nor applicable to the Settling PRPs.

REVISIONS RE: Participation.

The parties agree that upon the filing of the Decree with the Court, all potentially responsible parties ("PRPs") with respect to this Facility will have a period of sixty (60) days

within which to execute the Decree. Following this sixty (60) day period, any non-settling PRP must comply with the provisions of this Decree, in particular paragraph 10, as a condition to entering into a consent decree, consent judgment, or settlement with the U.S. EPA as to this Facility. In no event shall the owner/operator defendants perform less than 65% of the SOW.

REVISION: Inconsistent Terms.

The terms and conditions of this addendum govern over any and all other agreements or orders, including the Decree.

REVISION: PERFORMANCE OF THE WORK BY SETTLING PRPS

The U.S. EPA and State agree that the work set forth in Exhibit A, if properly performed, is in accordance with Section 121 of CERCLA, 42 U.S.C. §9621, and with the National Contingency Plan ("NCP"), consistent with paragraph 78 of the Consent Decree.

CHANGE: Certification of Completion of Remedial Action.

Paragraph 85 of the Decree is stricken by this Addendum and the following is substituted:

a. Application. When the Settling PRPs believe that the work to be performed in Exhibit A has been completed and that a demonstration of compliance with Cleanup and Performance Standards has been made in accordance with this Decree, they shall submit to the United States and the State a Notification

of Completion of the Customer Portion of the Work and a final report which summarizes the work done, any modification made to the SOW or Work Plan(s) thereunder relating to the cleanup and Performance Standards, and data demonstrating that the Cleanup and Performance Standards have been achieved.

b. Certification. Upon receipt of the Notice of Completion, U.S. EPA shall review the final report and supporting documentation, and the remedial actions taken. U.S. EPA, in consultation with the State, shall issue a Certification of Completion upon a determination that Settling PRPs have completed the work set forth in Exhibit A and demonstrated compliance with Cleanup and Performance Standards, and that no further corrective action is required by the Settling PRPs.

REVISION: MODIFICATION OF THE ROD OR SOW

8. Once the RD is complete and the final version of Exhibit A has been agreed upon by the parties, the Settling PRPs will have no responsibility or liability for any additions or changes to the ROD or SOW, subject only to the reopener provision contained in this Addendum.

9. Any change or modifications to the ROD or SOW which reduces the overall cost of the Remedial Action taking place at the Facility shall cause a commensurate reduction in the Customer Portion of the Work as set forth in Exhibit A. Should this adjustment not be possible, either in whole or part, at the time of the change or modification, then the Settling PRPs

shall be entitled to reimbursement from the non-settling PRPs, consistent with the terms and conditions of this Addendum.

VI. STIPULATED PENALTIES, REIMBURSEMENT, AND PREMIUMS

10. Penalties for Settling and Non-Settling PRPs.

a. Section XVII and all paragraphs thereunder of this Decree are replaced by Exhibits A and B. Exhibit B sets forth any and all penalties to be incurred in the event of untimely performance by the Settling PRPs.

b. Any PRP who signs this Decree or otherwise settles with the U.S. EPA after the sixty day period, is subject to the provisions of this subparagraph (b). Such settlement or execution shall be conditioned on the payment by that PRP of its volumetric share of the Customer Portion of the Work, plus interest to date on any unpaid portion due and owing, and, a premium. All PRPs subject to this subparagraph (b) shall pay the premium as calculated in Exhibit C, which premium shall be based upon a percentage of the orphan share of the Customer Portion of the Work. All moneys collected pursuant to this subparagraph (b) shall go to the Settling PRPs.

c. Nothing herein shall be deemed in any way to limit, bar, or restrict any claim, defense, action, penalty, or remedy whatsoever which the U.S. EPA, the State, or the Settling PRPs may have against any person not a party to the agreement.

d. As to the Settling PRPs, natural resources damages shall be considered a covered matter, under paragraph 66 of the Consent Decree.

VII. FINANCIAL RESPONSIBILITY AND DEMINIMUS DEFENDANTS

11. Settling PRPs shall provide financial security, in the amount of \$10,000,000 in one of the forms permitted under 40 C.F.R. 264.145, to assure completion of the Customer Portion of the Work at the Facility. Other than penalties recovered by the U.S. EPA or the State, any and all moneys collected from non-owner/operator PRPs shall be applied to the Customer Portion of the Work at the Facility.

12. The U.S. EPA agrees to assist the Settling PRPs in securing participation in the Customer Portion of the Work from those PRPs who did not receive the §106 order.

VIII. FAILING OWNER/OPERATOR DEFENDANTS

13. To the extent that the owner/operator defendants or their successors are discharged in a proceeding under the U.S. bankruptcy laws for their liability under CERCLA for the Facility, and there is no other entity or corporation, pursuant to either federal or state law, responsible for their portion of the work, as a result of any theories of succession, EPA reserves the right to seek from the Settling PRPs performance of such work.

4/19/91

NL INDUSTRIES/TARACORP ROD COST ESTIMATION

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (Areas 1-3)	712	\$1,233 Areas 1-8; FS esti
Indirect Capital Costs (45%) Contingency (25%) Engineer (15%) Legal (5%)	1,032	
Bottom Liner	133	FS adj esti
Indirect Capital Cost (45%)	193	
SLLR Pile	109	FS esti
Indirect Capital Cost (45%)	158	
Contained Drosses	6.5	FS esti
Indirect Capital Cost (45%)	9.4	
Area 1	1,663	ROD esti
Indirect Capital Cost (45%)	2,411	
Area 2	1,603	FS esti
Indirect Capital Cost (45%)	2,324	
Area 3 (4,750 CY)	491	CY x \$103.3/CY
Indirect Capital Cost (45%)	712	
Other Costs	994	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Indirect Capital Cost (45%)	1,441	
Blood-Lead Survey	200	EPA esti
Alleys-Venice, Eagle Park, etc	748	FS esti 106 w/ 7 fold factor
Indirect Capital Cost (45%)	1,085	
Eagle Park Acres Ditch	1,186	FS esti 118 w/ 10 fold factor
Indirect Capital Cost (45%)	1,719	

Annual O/M	53	FS esti 35
Indirect Capital Cost (45%)	77	For WP&Reports
Present Worth - 30 yr, 5%	1,177	
Air Monitoring	0.5	FS esti
Air Sample Analysis	8	FS esti
Groundwater Sampling	8.5	FS esti 1.8
Groundwater Analysis	14.3	Indi after yr 2
Site Mowing	6.5	FS esti
Site Inspection	2	FS esti
Misc Site Work/Repair	9	FS esti
Site Work Materials	4	FS esti

New Estimates Outside of FS

Area 4 (26,600 CY)	2,748	CY x \$103.3/CY
Indirect Capital Cost (45%)	3,985	
Area 5 (5,560 CY)	393	CY x \$103.3/CY
Indirect Capital Cost (45%)	570	
Area 6 (9,500 CY)	982	CY x \$103.3/CY
Indirect Capital Costs (45%)	1,424	
Area 7 (4,750 CY)	491	CY x \$103.3/CY
Indirect Capital Costs (45%)	712	
Area 8 (34,200 CY)	3,533	CY x \$103.3/CY
Indirect Capital Costs	5,123	
Extra Multi-layer Cap Area	521	FS adj esti
Indirect Capital Cost (45%)	756	
Additional Bottom Liner	534	FS adj esti
Indirect Capital Cost (45%)	774	
Other Costs	940	
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	500	FS esti 40
Equip't Decon	200	FS esti 40
Indirect Capital Cost (45%)	1,363	
Home Interior Inspections	231	\$150/house
Indirect Capital Cost (45%)	335	
Other Contingency Measures	104	see assumptions
Indirect Capital Cost (45%)	151	
Remedial Design Investigation	1,266	EPA/PRP esti.
<u>Total</u>	28,920	

Total Costs do not include Contingency Plans/Measures

"Settling NL Customers" means the NL Customers which execute this Decree within sixty (60) days of its being filed with the Court.

INSERT H

The Settling Major NL Customers agree jointly and severally to perform the NL Customer Work as defined in Exhibit A according to the schedule contained therein, commencing when the Decree is filed with the Court. The NL Customer Work represents 35% of the costs of the work contemplated under the SOW. The commitment of the Settling Major NL Customers to perform such work shall be null and void in the event that the Owner/Operator PRPs enter into a settlement with U.S. EPA within a sixty (60) day period. Following completion of the RD, certain modifications to the NL Customer Work may be required, in which case the Settling Major NL Customers shall revise Exhibit A consistent with the provisions of this Decree and subject to the review of U.S. EPA; provided, however, that in no event shall the work to be performed pursuant to this Decree exceed 35% of the cost of the SOW. Any disputes with respect to revisions to the NL Customer Work shall be subject to the dispute resolution provisions of Section XIV hereof. The Section 106 Order is modified as to all Settling NL Customers, who are hereby removed from the scope and authority of that Order.

INSERT I

1. Once the RD is complete and the final version of Exhibit A has been agreed upon by the parties or determined by the Court pursuant to Section XIV, the Settling NL Customers shall have no responsibility or liability for any additions or changes to the ROD or the SOW, or for additional work at the Facility, subject only to the paragraph 3 of this section.

2. In the event that the ROD or SOW is modified to reduce the overall cost of the remedial action at the Site, whether pursuant to U.S. EPA action or Court order, U.S. EPA shall make a commensurate reduction in the NL Customer Work as set forth in Exhibit A, such that the NL Customers are responsible for no more than 35% of the total cost of such remedial action.

3. In the event that the liabilities of all of the Owner/Operator PRPs and their successors under CERCLA and the Resource Conservation and Recovery Act with respect to the Facility are discharged in a proceeding under the U.S. bankruptcy laws, and in the further event that there is no other person responsible under federal or state law from which U.S. EPA can recover for costs of remedial work at the Facility, U.S. EPA reserves the right to seek to require the Settling NL Customers to perform work in addition to the NL Customer Work.

INSERT J

XVII-A.

**FUTURE SETTLEMENTS WITH
NON-SETTLING NL CUSTOMERS**

It is U.S. EPA's present intention to file suit against Non-Settling NL Customers seeking performance of the remedial action work plan pursuant to the terms of the Section 106 Order, triple the costs expended by U.S. EPA, if any, in performing the remedial action work plan or portions thereof, and civil penalties of \$25,000 per day. U.S. EPA shall not enter into a settlement with any Non-Settling NL Customer unless such Non-Settling Customer shall pay, at a minimum, its volumetric share of the Projected Cost of the NL Customer Work, multiplied by the Participation factor, multiplied by the Non-Settler Premium Factor. U.S. EPA shall allocate and distribute the proceeds of each judgment against or settlement with any such Non-Settling NL Customer as follows:

(1) first, an amount equal to the Non-Settling NL Customer's Percentage Share, multiplied by the Participation Factor, multiplied by the Projected Cost of the NL Customer Work, multiplied by the Non-Settler Premium Factor, shall be deposited in the NL Customer Trust Fund;

(2) second, the remaining amount, plus any portion of the total judgment or settlement representing a civil penalty, shall be deposited in the U.S. Treasury.

It is also U.S. EPA's present intention to file suit against the owner/operators of the Facility seeking performance of 65% of the work required by the remedial action work plan, triple the costs expended by U.S. EPA, if any, in performing the remedial action work plan or portions thereof, and civil penalties of \$25,000 per day. U.S. EPA shall allocate and distribute the proceeds of each judgment against or settlement with any such Non-Settling NL Customer as follows:

(1) first, in the event that the sum recovered by U.S. EPA, other than civil penalties, exceeds 65% of the cost of implementing the remedial action work plan, a portion of such excess amount, not to exceed the share of the cost of the NL Customer Work attributable on a volumetric basis to NL Customers determined by U.S. EPA to be insolvent or otherwise non-viable, shall be distributed to the NL Customers Trust Fund;

(2) second, the remaining amount, plus any portion of the total judgment or settlement representing a civil penalty, shall be deposited in the U.S. Treasury.

XVII-B. NL CUSTOMER TRUST FUND

Within ___ days after filing this Decree with the Court, the Settling NL Customers shall create the NL Customers Trust Fund at a national bank approved by U.S. EPA pursuant to a trust agreement substantially similar to the draft agreement attached hereto as Exhibit ___. All contributions from Settling NL Customers toward implementation of the NL Customer Work shall be deposited in the NL Customer Trust Fund.

Upon completion of the NL Customer Work, any funds remaining in the NL Customer Trust Fund shall be distributed as follows:

(1) first, the Major Settling NL Customers shall be entitled to a pro rata distribution of such remaining funds based on each such Customer's Percentage Share, each such distribution not to exceed (a) the amount paid by each such Customer to fund the NL Customer Work, less (b) the product of that Customer's Percentage share multiplied by the cost of the NL Customer Work, as determined by a final accounting;

(2) second, any remaining amount shall be paid to the U.S. Treasury.

XVII-C. DE MINIMIS SETTLEMENT

In order to settle, each De Minimis Settlers shall pay to the NL Customers Trust Fund the amount specified for such party in Appendix ___. The payment made by each De Minimis Settlor represents its volumetric share of the estimated costs of the NL Customer Work (\$_____), oversight costs \$_____, past costs incurred by USEPA and IEPA \$_____, and Natural Resource Damage Claim \$_____. Each payment also includes a premium of 200% of such party's volumetric share of the estimated cost of the NL Customer Work and oversight costs, which is designed to pay for any and all response costs to be incurred by the Settling Major NL Customers, including but not limited to, cost overruns incurred during implementation of the remedy.

Each payment shall be made by certified or cashier's check payable to the NL Customers Trust Fund. Each check shall state the name and address of the De Minimis Settlor. Such payment shall be remitted to: _____

The United States, the State of Illinois, and the Settling NL Customers covenant not to sue or to take any other civil or administrative action against any De Minimis Settlor, or other officers, directors, employees, successors, and assigns, for Covered Matters. Covered Matters shall include any and all civil liability to the United States, the State, and the RD/RA Settlers for causes of action arising under Section 106 and 107(a) of CERCLA, 42 U.S.C. 9606, 9607(a), Section 7003 of RCRA, 42 U.S.C.

9673, and Ill. Rev. Stat. ch. __, § __, and common law nuisance, and relating to the Facility. Covered Matters shall also include any and all civil liability for Private Party Response Costs, as well as any and all civil liability for response costs relating to the Facility paid by any Settling Major NL Customer. These covenants not to sue for present and potential future liability shall take effect as to each De Minimis Settlor after that De Minimis Settlor has made timely and full payment pursuant to paragraph __ of this Decree.

Nothing in this Consent Decree is intended nor shall it be construed as a release or a covenant not to sue for any claim or cause of action, administrative or judicial, civil or criminal, past or future, in law or in equity, which the United States, the State, or any Settling NL Customer may have against any of the De Minimis Settlers for:

- a. any liability as a result of a failure to make the payments required by paragraph __ of this Decree;
- b. any matters not expressly included in Covered Matters; and
- c. criminal liability.

If information not currently known to the United States is discovered which indicates that any De Minimis Settlor contributed hazardous substances to the Facility in such greater amount or of such greater toxic or other hazardous effect that the De Minimis Settlor no longer qualifies as a De Minimis party at the Facility because such party contributed greater than 0.4% of the hazardous substances disposed of at the Facility or contributed disproportionately to the cumulative toxic or other hazardous effect of the hazardous substances at the Facility then the covenants not to sue set forth above and the contribution protection referred to in Section __ are null and void as to that De Minimis Settlor.

By signing this Consent Decree, each De Minimis Settlor certifies to the best of its knowledge and belief, the following:

- a. The De Minimis Settlor has made reasonable inquiry to gather all information which relates in any way to its ownership, operation, generation, treatment, transportation, storage, or disposal of hazardous substances at or in connection with the Facility, and has provided to the United States all such information; and
- b. The information referred to in U.S. EPA's volumetric ranking for the Facility is materially

true and correct with respect to the amount of hazardous substances or other wastes that the De Minimis Settlor may have shipped or arranged to be shipped to the Facility.

INSERT K (Note: Inserts I and K are the same because I wasn't sure where to place this concept)

1. Once the RD is complete and the final version of Exhibit A has been agreed upon by the parties or determined by the Court pursuant to Section XIV, the Settling NL Customers shall have no responsibility or liability for any additions or changes to the ROD or the SOW, or for additional work at the Facility, subject only to the paragraph 3 of this section.

2. In the event that the ROD or SOW is modified to reduce the overall cost of the remedial action at the Site, whether pursuant to U.S. EPA action or Court order, U.S. EPA shall make a commensurate reduction in the NL Customer Work as set forth in Exhibit A, such that the NL Customers are responsible for no more than 35% of the total cost of such remedial action.

3. In the event that the liabilities of all of the Owner/Operator PRPs and their successors under CERCLA and the Resource Conservation and Recovery Act with respect to the Facility are discharged in a proceeding under the U.S. bankruptcy laws, and in the further event that there is no other person responsible under federal or state law from which U.S. EPA can recover for costs of remedial work at the Facility, U.S. EPA reserves the right to seek to require the Settling NL Customers to perform work in addition to the NL Customer Work.

INSERT L

Nothing herein shall be deemed to limit, bar, or otherwise restrict any claim, defense, action, penalty, or remedy that any Party to this Decree may have against any person not a party to the Decree.

INSERT M

The Court hereby finds that this Consent Decree has been negotiated in good faith and constitutes a resolution by the Settling NL Customers of their liability, including that under CERCLA and Section 7003 of RCRA, to the United States and State for the covered matters of this Decree. The parties agree, and the Court hereby finds that Settling NL Customers have resolved their liability to the United States within the meaning of Section 113(f)(2) of CERCLA and are not liable for claims for contribution arising out of any matters addressed in this Consent Decree.

INSERT N

Upon filing this Decree with the Court, all NL Customers shall have a period of sixty (60) days within which to execute the Decree. It is U.S. EPA's present intention that following this sixty (60) day period no NL Customer shall be allowed to become a party to this Decree, or to otherwise compromise or settle its liability under CERCLA and under the 106 Order with respect to the Site, without payment of a substantial premium over its volumetric share of the cost of the NL Customer Work and without payment of a substantial civil penalty.

INSERT O

If EPA does not respond to Respondents' request within thirty (30) days after receipt of Respondents' letter, Respondents may invoke Section XIV, Dispute Resolution procedures.

INSERT P

By entering into this Consent Order, or by taking any action in accordance with it, the Settling NL Customers do not admit any of the findings of fact, conclusions of law, determinations or any of the allegations contained in this Consent Order, nor do Settling NL Customers admit liability for any purpose or admit any issues of law or fact or any responsibility for the alleged release or threat of release of any hazardous substance into the environment. The participation of any Settling NL Customers in this Consent Order shall not be admissible against Settling NL Customers in any judicial or administrative proceeding, except for an action by EPA or the State to enforce the terms of this Consent Order.

It is the intent of the parties hereto that neither the terms of this Consent Decree, including any allegation, finding, conclusion, or determination set forth herein, nor the act of performance hereunder, shall be used against Settling NL Customers as a collateral estoppel in any other proceeding with EPA, the State, or with any other governmental agency, or with any other person.

By signing and consenting to this Consent Order or by taking any actions pursuant to this Consent Order, Settling NL Customers do not concede that the activities required herein are necessary to protect the public health or welfare or the environment, or for any other reason; that the methodologies or protocols prescribed by applicable EPA guidance or described or noted herein or otherwise required by EPA for performance of work pursuant to this Consent Decree are the only ones appropriate for

the proper conduct of the activities required herein, or, that a release or threatened release of a hazardous waste or substance at or from the Facility, or any disposal of a hazardous waste or substance at the Facility, may present an imminent and substantial endangerment to the public health or welfare or the environment.

COMMITTEE CORRESPONDENCE

Address Writer at
ENVIRONMENTAL ACTIVITIES STAFF, GENERAL MOTORS CORPORATION
GENERAL MOTORS TECHNICAL CENTER 30400 MOUND ROAD
WARREN, MICHIGAN 48090-9015

Date: February 19, 1991

Subject: NL Industries/Taracorp Carve-out and Participation

From: D.J. Bicknell **DJB**

To: B. Bradley, EPA - Remedial Project Manager

General Motors (GM) has through much independent and joint PRP effort attempted to facilitate a RD/RA settlement with EPA - Region V concerning the NL Industries/Taracorp, IL Superfund site. We believe that the gains made by EPA and the potential settling generators present the possibility to attain a partial generator Consent Decree. Attached is a carve-out of work and overall cost estimate revised in accordance with our technical discussions on February 14. Also attached are two tables identifying those which have determined to not participate in the settlement process.

The carve-out of work includes a new item, "additional remedial design cost". In the past the engineering portion of the indirect capital costs for all the components of the ROD were not reflected in the carve-out, since the settling generators were never going to do all the ROD work. This cost needs to be included since the settling generators are offering to do all the remedial design engineering of the ROD remedy.

The two tables show that the potential settling generators are bearing more than three times their fair-share of the costs in this possible settlement. In fact only one of the top six companies is a participant in this settlement. I provide this information for your consideration, because the existing settling group is at or potentially beyond its limits.



It is GM's belief that any increase in the costs of the carve-out, or lack of comprehensive contribution protection or strong incentives to settle will break the generator coalition. I provide this information so you can better understand the positions of the potential settling generators vis-a-vis the many recalcitrant PRPs.

Attachment

cc: A. Held, DOJ

S. Siegel, ORC

NL INDUSTRIES/TARACORP, IL SUPERFUND SITE

Major Non-Settling Generators

<u>Major Non-Settling Generators</u>	<u>Percentage</u>
1 Johnson Controls	14.69639
3 Exide (ESB and General Battery)	5.04326
7 Ace Scrap Metal	3.91678
Allied-Signal	2.63965
12 Sanders Lead	1.69361
12 U.S. Steel Lead Refinery	<u>1.41027</u>
Total	29.399964

GRANITE CITY SITE

RANK	NAME	VOLUME (LBS)	PERCENTAGE	NP/NVP/P	RANK	NAME	VOLUME (LBS)	PERCENTAGE	NP/NVP/P
MAJOR GENERATORS					30	MADDELL BROTHERS METAL COMPANY	3,316,000.00	0.70346	NVP
1	GLOBE UNION	60,125,205.00	14.60439	NP	31	LISSENE CORPORATION	3,201,075.00	0.68050	NVP
2	AT&T	50,125,995.00	12.35024	P	32	HENRYS TUCK CO. INC.	2,947,510.00	0.62667	NP
3	EOB - <i>Exide</i>	20,023,090.00	4.25727	NP	33	HICKINLEY IRON COMPANY	2,945,237.00	0.62619	P
4	ACE SCRAP METAL PROCESSORS	10,422,256.48	3.91678	NP	34	CENTRAL IRON & METAL COMPANY	2,630,632.00	0.95930	P
5	SOUTHERN SCRAP I & II METAL PROCESSING	14,592,315.00	3.10249	NP	35	VERSATILE METALS	2,524,160.00	0.53467	P
6	PRESTOLITE BATTERY	12,415,383.40	2.63965	NP	36	ADF METAL COMPANY	2,484,695.00	0.52827	NVP
7	COPHER SMELTING & REFINING COMPANY	11,402,485.00	2.44131	P	37	COMMERCIAL METALS COMPANY	2,429,042.00	0.51644	P
8	STRAIGHTWAY IRON & METAL COMPANY	11,430,778.00	2.43031	NVP	38	DEL RICH BATTERY & METAL COMPANY	2,391,740.00	0.50851	NVP
9	PHILIPP BROTHERS, INC.	8,774,614.40	1.80558	P	39	FENBERG BROS.	2,361,466.00	0.50007	NVP
10	FEDERAL CARTRIDGE CORPORATION	8,443,607.00	1.79322	P	40	SEIDENFELD & SON IRON & METAL	2,344,095.00	0.49851	NVP
11	FINER METAL COMPANY	7,971,574.00	1.69485	NVP	41	DEL TUCK & COMPANY	2,269,973.00	0.48262	NP
12	SANDERS LEAD COMPANY	7,905,770.00	1.69361	NP	42	INTERSTATE BATTERY SYSTEMS OF AMERICA	2,252,470.00	0.47890	P
13	GOULD, INC.	7,342,701.00	1.56114	P	43	SPRINGFIELD BATTERY COMPANY	2,220,312.00	0.47206	P
14	FEDERAL IRON & METAL COMPANY	7,203,213.00	1.54849	NVP	44	SHANKS METALS, INC.	2,067,764.00	0.43963	NVP
15	SUPPO SMELTING & REFINING COMPANY	6,671,060.00	1.41834	NVP	45	FORD MOTOR COMPANY	2,059,040.00	0.43369	P
16	U.S. STEEL LEAD REFINERY, INC.	6,633,081.00	1.41027	NP	46	CHAMEN'S, INC.	1,900,200.00	0.42101	NVP
17	ST. LOUIS LEAD RECYCLERS	6,274,060.00	1.33411	P	47	SURE-START BATTERY	1,959,100.00	0.41653	P
18	MISSOURI IRON & METAL COMPANY, INC.	5,970,522.00	1.26940	P					
19	CHENETCO	5,400,943.00	1.14830	P					
20	BECKER METALS CORPORATION	5,170,446.00	1.09951	P					
21	ED PARKINSON	5,142,945.00	1.09345	NVP					
22	ALTER COMPANY	5,105,540.00	1.07657	P					
23	A. MILLER & COMPANY	5,061,837.00	1.07620	NVP					
24	ACE BATTERY MANUFACTURING CO. INC.	4,905,760.00	1.05578	NP					
25	MADDELL & MADDELL	1,237,858.00	0.90527	P					
26	DELCO-BENTON DIVISION	4,100,761.00	0.89058	P					
27	VINCE JACKS IRON & METAL	4,142,581.00	0.88076	NVP					
28	GENERAL BATTERY CORPORATION - <i>Exide</i>	3,696,834.00	0.78599	NP					
29	SHOSTAK IRON & METAL CO., INC.	3,532,745.00	0.75110	NVP					

Volume 2

* NP - Non-Participant ≈ 34.18490

NVP - Non-Viable Party ≈ 15.66016

P - Participant ≈ 31.78501

* Factor for P to do all the Generator
Portion of Work - 100% ≈ 3.146
31.78501

Carve-out

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (Pile & Area 1)	712	\$1,233 Areas 1-8; FS esti
Indirect Capital Costs (45%)	1,032	
Contingency (25%)		
Engineer (15%)		
Legal (5%)		
Bottom Liner	133	FS adj esti
Indirect Capital Cost (45%)	193	
SLLR Pile	109	FS esti
Indirect Capital Cost (45%)	158	
Contained Drosses	6.5	FS esti
Indirect Capital Cost (45%)	9.4	
Area 1	1,663	ROD esti
Indirect Capital Cost (45%)	2,411	
Remedial Design Investigation	1,266	EPA/PRP esti
Additional Remedial Design Cost	476	PRP esti
EPA Past Costs	300	EPA esti
Cash-out of Work	2,190.3	\$100K/22 yr
Blood-Lead Survey	500	EPA esti
Other Costs	1,094	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Fence	100	PRP esti
Indirect Capital Cost (45%)	1,586.3	
<u>Total</u>	10,122.0	

* If the RD cost estimate is < or > 10% of the \$ 28.9 million value, work may be added to or deleted from the above units to maintain a 35% generator carve-out.

Carve-out

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (File & Area 1)	712	\$1,233 Areas 1-8; FS esti
Indirect Capital Costs (45%)	1,032	
Contingency (25%)		
Engineer (15%)		
Legal (5%)		
Bottom Liner	133	FS adj esti
Indirect Capital Cost (45%)	193	
SLLR File	109	FS esti
Indirect Capital Cost (45%)	158	
Contained Drosses	6.5	FS esti
Indirect Capital Cost (45%)	9.4	
Area 1	1,663	ROD esti
Indirect Capital Cost (45%)	2,411	
Remedial Design Investigation	1,266	EPA/PRP esti
Additional Remedial Design Cost	476	PRP esti
EPA Past Costs	300	EPA esti
Cash-out of Work	2,190.3	\$100K/22 yr
Blood-Lead Survey	300	EPA esti
Other Costs	1,094	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilisation	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Fence	100	PRP esti
Indirect Capital Cost (45%)	1,586.3	
<u>Total</u>	<u>10,122.0</u>	

* If the RD cost estimate is < or > 10% of the \$ 28.9 million value, work may be added to or deleted from the above units to maintain a 35% generator carve-out.

Carve-out

<u>Unit of Work</u>	<u>Cost (\$000)</u>	<u>Comments</u>
Multi-layer Cap (Pile & Area 1)	712	\$1,233 Areas 1-8;
Indirect Capital Costs (45%)	1,032	FS esti
Bottom Liner	133	FS adj esti
Indirect Capital Cost (45%)	193	
SLLR Pile	109	FS esti
Indirect Capital Cost (45%)	158	
Contained Drosses	6.5	FS esti
Indirect Capital Cost (45%)	9.4	
Area 1	1,663	ROD esti
Indirect Capital Cost (45%)	2,411	
Alleys-Venice, Eagle Park, etc	748	FS esti 106 w/
Indirect Capital Cost (45%)	1,085	7 fold factor**
Remedial Design Investigation	1,266	EPA/PRP esti
EPA Past Costs	300	EPA esti
Cash-out of Work	1,684.3	Applied at EPA's discretion**
Blood-Lead Survey	500	EPA revised esti
Other Costs	1,094	Revised esti
Monitoring Well	14	FS esti 1.8
Deed Restrictions	15	FS esti
Safety Program	40	FS esti
Mobilization	300	FS esti 65
Dust Control	400	FS esti 40
Equip't Decon	200	FS esti 40
Off-site Drainage	25	FS esti
Fence	100	PRP esti
Indirect Capital Cost (45%)	1,586.3	
<u>Total</u>	<u>10,225.0</u>	

* If the RD cost estimate is < or > 10% of the \$ 29.21 million value, work may be added to or deleted from the above units to maintain a 35% generator carve-out.

** If Johnson Control, Allied-Signal, and Exide are settling parties, then Area 2 or 3 residential work may be substituted for all or part of the asterisk units of work on an equivalent cost basis, while maintaining a 35% generator carve-out.

SIDLEY & AUSTIN

A PARTNERSHIP INCLUDING PROFESSIONAL CORPORATIONS

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February 16, 1991

BY TELECOPIER AND MESSENGER

Steven M. Siegel, Esq.
Assistant Regional Counsel
U.S. EPA
230 S. Dearborn Street
Chicago, Illinois 60604

Re: NL Industries/Granite City Site

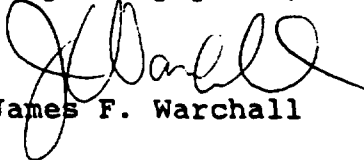
Dear Mr. Siegel:

I have enclosed several pages¹ from a marked-up version of the NL Granite Cities Consent Decree, as well as several proposed inserts to the Decree. In my Saturday Fax, I have not sent the other pages of the Decree where either no, or very minor, changes have been made.

I believe that the inserts provide a little more detail regarding the provisions we would like to see incorporated in the Consent Decree than did the materials which Joe Nassif has previously sent to you. Although Joe indicated to me in a telephone conversation this afternoon that, based on a telephone conversation he had with you late on Friday, you may not be receptive to several of the provisions, I nevertheless included them for the sake of discussion.

Please call me if you have any questions regarding the enclosures. My office number is (312) 853-7692; my home number is (708) 304-8730. Feel free to call me at home over the weekend if I can be of assistance.

Very truly yours,


James F. Warchall

cc Joseph Nassif
Al Schlesinger
Mark Hester

¹ Pages 2, 4, 5, 7-12, 14-24, 27, 38-40, 45-48 & 50-55.

**INSERTS TO 2/16/91 MARK-UP OF
NL CUSTOMERS CONSENT DECREE**

INSERT A

The PRPs so notified by U.S. EPA include the present and former owners and operators of the Site and 362 companies and individuals that U.S. EPA has alleged consigned hazardous substances to the facility (hereinafter referred to as "NL Customers");

INSERT B

Negotiations with the PRPs for implementation of the remedial action plan were unsuccessful and on November 27, 1990 U.S. EPA issued a Unilateral Administrative Order pursuant to Section 106 of CERCLA against the current and former owner/operators of the Facility and 47 NL Customers, each of which is alleged to have consigned more than 0.04% of the total materials allegedly consigned to the Facility (such companies are hereinafter referred to as the "Major NL Customers");

The current and former owner/operators of the Facility refused to comply with the Order, although several of the Major NL Customers have proposed to perform 35% of the work required by the remedial action plan, which they believe is an appropriate share of the work required by the remedial action plan to be performed by the all of the NL Customers;

U.S. EPA agrees that 35% of the work required by the remedial action plan is an appropriate share for all of the NL Customers (such work is hereinafter referred to as the "NL Customer Work");

INSERT C

to modify the Section 106 Order to remove the Settling NL Customers, as defined herein, as respondents to that Order, and to assure that the Settling NL Customers are adequately protected in light of their undertaking to perform the NL Customer Work.

INSERT D

"De Minimis Settlers" means the Settling NL Customers which, pursuant to U.S. EPA's volumetric ranking for the Site, are alleged to have consigned less than 0.4% of the total hazardous substances alleged to have been consigned to the Site.

INSERT E

"Major NL Customers" means the NL Customers which, pursuant to U.S. EPA's volumetric ranking for the Site, are alleged to have consigned 0.4% or more of the total hazardous substances alleged to have been consigned to the Site.

"NL Customers" means any person alleged by U.S. EPA to have consigned hazardous substances to the Site, including the 362 persons listed on U.S. EPA's volumetric ranking for the Site, but not including the Owner PRPs."

"NL Customer Trust Fund" means the trust fund established pursuant to the terms of Section XVII-B of this Decree.

"NL Customer Work " means the work set forth in the Scope of Work "SOW") attached hereto as Exhibit A, which work constitutes, by cost, approximately 35% of the remedial action work plan.

"Non-Settler Premium Factor" means 1.3 (?).

"Oversight Costs" means any direct costs not inconsistent with the National Contingency Plan actually incurred and paid by the U.S. EPA or the State of Illinois in monitoring the compliance of the Settling NL Customers with this Decree, including but not limited to contractor costs, sampling and laboratory costs, and travel costs, but excluding indirect costs and interest that accrued prior to the time that this Decree is entered.

INSERT F

"Participation Factor" means 0.81 divided by the Settling Major NL Customers Aggregate Percentage Share.

"Percentage Share" means the individual percentage shares of each NL Customer as set forth on U.S. EPA's volumetric ranking for the Site, expressed as a decimal (e.g., 5% is expressed as 0.05).

"Projected Cost of the NL Customer Work" means \$__ million.

INSERT G

"Settling Major NL Customers" means the Major NL Customers which execute this Decree within sixty (60) days of its being filed with the Court.

"Settling Major NL Customers Aggregate Percentage Share" means the sum of the Percentage Shares of each Settling Major NL Customer.